

# JOURNAL

VOLUME 85

JANUARY  
1961

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# GRAMMAR SCHOOL CHEMISTRY

A disturbing report has recently been published\* for the Science Masters' Association, in which the inadequacy of grammar-school provisions for the practical study of chemistry shows up clearly. The report is based on a survey conducted jointly by the Science Masters' Association, the Association of Women Science Teachers, the National Union of Teachers and the Joint Four Associations. It covers 694 grammar schools widely distributed over England and Wales which together teach some 374,000 pupils. It reveals some improvements since an earlier survey in 1957, but also shows that many critical difficulties still remain. Generally speaking, boys' and mixed schools are still better provided with facilities than are girls' schools.

During the first three years almost all pupils do some science. In the fifth year, when the 'O' level examination is customarily taken, about 90 per cent of the pupils are still studying science. In the sixth form, in girls' schools, the proportion—including those who are *not* specializing in science—is sometimes as low as 46 per cent and in boys' schools as low as 66 per cent.

The number of sixth-formers who are *specializing* in science in girls' schools is usually less than half that in the boys' schools (which is about 60 per cent).

Since 1957 there has been a small increase in the average size of sixth forms, but in some of the smaller girls' and mixed schools some sixth forms appear to be uneconomically small. Boys tend to concentrate upon physics and chemistry and girls upon biology. Judging from the sample of 13,626 pupils examined in science subjects, physics has become established as the most widely taken subject (10,619); chemistry was taken by 8,603, biology by 2,091, zoology by 1,987, botany by 1,430 and geology by 146.

## STANDARDS OF LABORATORIES

The average standard of laboratory provision in the 547 L.E.A. schools examined is disappointing; only 45 per cent have laboratory provision in accordance with the Ministry of Education's own recommendations, compared with 44 per cent in 1957. Only *four* of the L.E.A. schools (0.7 per cent) reach the higher standard set by the Industrial Fund for the Advancement of Scientific Education in Schools, which has assisted many direct grant and independent schools over the last few

years. Throughout England and Wales the number of new laboratories and those under construction in the L.E.A. schools during 1958–59 was 486, and permission has been given for the building of 482 more. Even when this work is completed, the L.E.A. grammar schools will still fall far short of direct grant and independent schools in this respect.

In 1957 the position as regards ancillary rooms used in connection with the teaching of science was extremely bad. The situation has now improved slightly. In 1959, 34 per cent of L.E.A. grammar schools were adequately equipped with preparation rooms, compared with 21 per cent in 1957; 54 per cent with balance rooms or chemical stores, compared with 52 per cent in 1957; and 16 per cent with workshops, compared with 10 per cent two years before. Again, the L.E.A. grammar schools are worse equipped than the direct grant and independent schools.

The direct grant and independent boys' schools have increased their provision of laboratory assistance since 1957, but the position in L.E.A. schools, as shown by the sample of 568 schools, is slightly worse. According to the standards of laboratory space recommended by the Ministry, and the number of technicians per laboratory considered necessary by the Science Masters' Association, *ONLY 10 per cent of L.E.A. Grammar Schools* can be said to be satisfactorily provided with laboratory assistance.

Five years ago the S.M.A. pointed out that the absence of laboratory technicians means that the teacher finds himself with less time than he should have for his normal teaching duties, the planning of his work, and the development of new apparatus and techniques. He has no time to design and arrange practical work that can be carried out by the pupils themselves, and all too frequently lessons become 'chalk and talk' illustrated with a few demonstration experiments. In such circumstances much of the teacher's energy is being wasted on work for which his training and gifts are not necessary.

## EXPENDITURE ON SCIENCE APPARATUS

The following table shows the money spent per annum per pupil taking science, excluding books and stationery. The amounts shown cover all three subjects—physics, chemistry and biology.

Total number of schools in sample	Type of school	Boys	Girls	Mixed
578	L.E.A. Grammar	12s. 3d.	8s. 8d.	10s. 10d.
54	Direct Grant	21s. 11d.	8s. 3d.	—
43	Independent	27s. 1d.	9s. 8d.	—
12	Comprehensive	—	—	4s. 9d.

\* *Provision and Maintenance of Laboratories in Grammar Schools* (1959). London: John Murray, 1960. 1s. net.



The financial position has not improved since 1957, and, in the words of the report, 'it seems unlikely that an amount of less than 12s. 6d. could possibly be adequate.' Science in the majority of the girls' and mixed schools is, therefore, inadequately financed.

#### CONCLUSIONS

In broad terms, the report reveals that:

- (a) Too few sixth-formers in girls' schools are taking science. Thus the great shortage of scientists in Britain is unlikely to be mitigated by an increased intake from these schools. Moreover, this situation is self-perpetuating. Few girls in the science sixth today means too few science mistresses on the staff later.
- (b) The ratio of 3 Science to 2 Arts students in boys' sixth forms may be reasonable, but it seems that the latter are dropping science too completely and too soon.
- (c) Even where science is studied to sixth-form level, the provision of laboratory space, equipment,

ancillary rooms and staff (science teachers as well as laboratory technicians) is inadequate in the majority of schools.

- (d) There seems to be a distinct inequality in the provision for science teaching as between girls' and boys' schools, even when allowance is made for the (regrettably) smaller number of girls taking science subjects.
- (e) Most science teachers are spending time in preparing equipment and carrying out other duties that could be satisfactorily performed by a laboratory technician.
- (f) Far more money must be spent, by L.E.A.s and by several independent and direct grant girls' schools, on improving the situation.

The above factual comment shows that the position is far from satisfactory and presents a national challenge.

The Institute, as the professional and qualifying body for chemists, has taken cognizance of the present state of affairs, and members, individually and collectively, should lose no opportunity of bringing the facts to the notice of those able to influence the position.

## SUGGESTED CHANGES IN THE CHEMISTRY SYLLABUS

By E. J. ROTHERY, B.Sc., M.I.C.I., A.R.I.C.

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The teaching of elementary chemistry has not altered appreciably in the recent past. Phlogiston theory hangs on grimly in many textbooks, and the atom is usually introduced by the inductive method of Dalton. Atomic weight is approached in a tortuous manner through the obsolete concept of equivalent weight and the laws of Dulong and Petit. Modern atomic theory is frequently hidden away in the appendix as an unwelcome accretion. The scientist has been described as a person who is always dissatisfied with things as they are, yet chemical education would appear to possess some strange inertia peculiar to itself.

In many countries important changes have already taken place. In Sweden, Denmark and Switzerland the Brønsted acid-base theory is used at an early stage in schools, and concepts of electronegativity are applied to a considerable degree. Valency is explained solely from electronic configuration. Atomic weight is derived from physics, and the concept of equivalent becomes superfluous.

More drastic reorganization of chemistry courses is now taking place in the United States. At a conference<sup>1</sup> held in June, 1957, at Reed College, Portland, Oregon, a new approach originated. It was decided that any beginners' course in chemistry should have a central

recognizable theme and that the Chemical Bond was the most logical choice. A course was drawn up on this basis and was called the 'Chemical Bond Approach' (C.B.A.). At present several teachers in American high schools are giving this course a trial.

In Greystones, Ireland, in March, 1960, representatives of 20 countries met under the auspices of the O.E.E.C. in an attempt to achieve the following objectives:

- (1) A revision of chemistry syllabuses based on the knowledge of the atom;
- (2) Pruning of the subject matter so as to give more time to fundamentals, without, however, neglecting experimental work;
- (3) Teaching chemical principles in such a way that they play a role in training the intellect of the pupil.

The report of this seminar will be published shortly by O.E.E.C. and we may expect recommendations for considerable changes in school chemistry.

A brief study of some of the major developments in chemistry in recent years will indicate a number of topics that might receive some treatment at the school level, *e.g.*: Principles of wave mechanics and quantum



theory; Electronegativity; Oxidation and reduction; Acid-base theory and chemistry of non-aqueous solutions.

#### PRINCIPLES OF WAVE MECHANICS

The fact that electrons show both wave and particle characters will be readily accepted if introduced at an early stage in chemistry, *e.g.* when light is being treated in the corresponding physics class. Difficult mathematical treatment could be neglected but the simple equations of de Broglie could easily be explained.

Quantum theory, indicating the discrete quantized properties of energy, is readily accepted by a student who is already aware of the relations between the laws of conservation of Mass and of Energy.

A seminar of mathematics teachers held recently in Paris under the auspices of O.E.E.C. suggested that some treatment of probability theory was essential in schools. A student, thus equipped, will readily accept  $\psi$  and  $\psi^2$  as a measure of the probability of the occurrence of the electron.

Heisenberg's Uncertainty Principle is of considerable value in the modern approach to chemical bonding. The electron, no longer viewed as a neat black dot on two-dimensional paper, must be regarded as a cloud spread over the region of space where the electron is most likely to occur, *i.e.* the orbital. The outer limits of the orbital are restricted because of the attraction of the positive nucleus for the negative electron. The inner limits are restricted by the Uncertainty Principle.

The various types of chemical bonds are readily understood if the student is familiar with the properties of electron clouds<sup>2</sup>: (a) Every part of an electron cloud repels every other part; (b) Two electron clouds and only two can occupy the same place at the same time (Pauli's Exclusion Principle).

Bearing in mind the laws of electrostatics, it follows that if a single electron and a single nucleus approach one another, the nucleus will move to the centre of the cloud. Thus the charge cloud will be spherical and will have a size determined by the balance between attractive and repulsive forces. If the nucleus is a proton, the structure corresponds to a hydrogen atom. By extending this simple qualitative picture, explanations of chemical bonds follow readily.

This method is the basis of the C.B.A. Approach, and present indications are that the trial courses in American high schools are extremely successful.

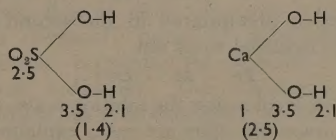
#### ELECTRONEGATIVITY

There is a growing body of opinion in chemical education today that certain fundamental information should be available to students at all times, including examinations. Periodic charts and tables of electronegativities are as essential to the chemistry class as logarithms to mathematics, and they should be as readily available.

A school certificate question might be visualized on the following lines.

*Question:* Both calcium hydroxide and sulphuric acid contain hydroxide groups, yet one ionizes to give hydroxyl ions and the other hydrogen ions. Why?

*Answer:* Ionization takes place between the atoms where the difference in electronegativity is greatest.



An intelligent student will, of course, ask the obvious question: how are these tables of electronegativity constructed? The explanation is not as easy as for logarithms, but some qualitative explanation of ionization potential and electron affinity might be given.

Electronegativity is defined simply as the tendency for atoms to gain electrons. Atoms of elements of high electronegativity attract additional electrons and form anions. They have small radii and their electronic configurations are one or two electrons short of the inert gas structure. Atoms of low electronegativity lose electrons and form cations. They have large radii and one or two electrons in the outer shell.

The three main characteristic types of bonds—covalent, ionic and metallic—may be readily explained in terms of electrons. In particular metallic and ionic bonds may be contrasted in terms of the elasticity of one and the brittleness of the other. Both properties are readily explained in terms of the types of bonds involved.

The dipole moment of water is greater than that of ammonia because the electronegativity difference between hydrogen and oxygen is greater than that between hydrogen and nitrogen. Thus intermolecular attraction is more likely to arise in water, giving rise to abnormal properties, such as its high boiling-point.

#### OXIDATION AND REDUCTION

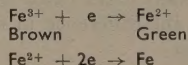
These phenomena may be defined simply as follows:  
*Oxidation:* Electron loss.      *Reduction:* Electron gain.

Clearly a substance of low electronegativity will readily donate electrons and act as a reducing agent (hydrogen, sodium, potassium, etc.), whereas substances of high electronegativity (fluorine, oxygen and chlorine) will accept electrons, thus acting as oxidizing agents.

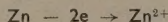
This is a simple picture when viewed solely in terms of electron transfer, yet textbooks today frequently 'explain' the phenomena in the most confusing terms. The obsolete concept of addition of oxygen or removal of hydrogen is widely used. To speak of a molecule increasing or decreasing its electronegativity (as most writers do) is equally confusing.



The simple explanation of electron transfer may be readily demonstrated with test-tube examples. Ferric chloride gives a brown solution. This is due to the ferric ion,  $\text{Fe}^{3+}$ . If this is mixed with a reducing solution (zinc and hydrochloric acid) the ion gains first one then two more electrons. Each change is marked by a change of colour in the solutions.

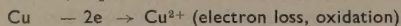
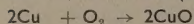
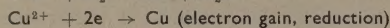
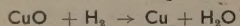


Metallic iron is precipitated in the second stage and zinc becomes oxidized to its ion.

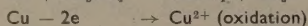
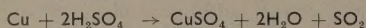


As the zinc ion is colourless the solution is also colourless.

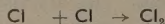
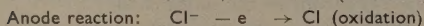
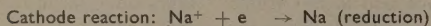
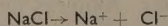
Other common examples are easily explained:



We may readily extend this simple picture to other reactions which are not usually described as oxidation-reduction reactions.



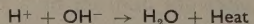
Electrolysis also may be described in these terms:



Thus electrolysis is readily explained as a simple electron-transfer reaction. This subject is usually complicated in schools by the unhappy choice of water as an example. 'Electrolysis of Water' should be called 'Electrolysis of dilute aqueous solutions of electrolytes'. The reactions also are too complex for elementary classes.

#### ACID-BASE THEORY AND REACTIONS IN NON-AQUEOUS SOLUTIONS

For many years it has been customary in school textbooks to represent acids and bases by means of the Arrhenius picture. Acids are regarded as substances which release hydrogen ions in aqueous solution. The ion is represented as a bare proton  $\text{H}^+$ . A base then produces hydroxyl ions in solution and acids neutralize bases giving water.



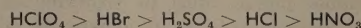
There are many objections which must be raised to this picture, *e.g.*

- (1) An acid does not release free protons into solution. Hydrogen ions are solvated protons (protons attached to one or more solvent molecule). This is also true of non-aqueous solvents.
- (2) The solvent is an essential agent in acid-base reactions. Pure anhydrous acids and bases will not combine without moisture.

- (3) Reactions in non-aqueous solutions and the existence of organic acids and bases are not readily explained by this theory.

On the other hand the Brønsted-Lowry concept of acids and bases readily overcomes these objections. It has considerable didactic advantages and is readily grasped by students who meet it at the outset. A student who is familiar with the proton will soon understand proton donors and acceptors. In more advanced school courses the existence of amphiprotic substances other than water could be demonstrated. Students frequently ask which acid is strongest. The teacher either states that several acids are of equal strength (on the basis of their ionization in water) or describes perchloric acid in rather vague terms without offering good reasons for its strength except that it is most dangerous!

Solution of strong acids in a weakly protophilic medium such as acetic acid makes possible a clear distinction between the strengths. The hydrogen ions now become  $\text{CH}_3\text{CO}_2\text{H}_2^+$ , and the extent of formation of this ion is dependent on the strength of the acid. Even perchloric acid is a comparatively poor conductor in acetic acid solution, and the order of decreasing strength is demonstrated:



There is an obvious relationship between electron donors and proton acceptors, or vice versa, and the teacher should relate these ideas as far as possible. This approach will lay a firm basis for the concepts of Lewis acids, nucleophilic and electrophilic reagents and so on.

The important differences<sup>3</sup> between proton transfer and electron transfer should also be stressed. For example, electron transfer often requires considerable time to take place or it may fail to occur except in the presence of a catalyst. Moreover loss and gain of electrons may take place in separate vessels. On the other hand many examples may be found of reactions involving both proton transfer and electron transfer, *e.g.* reduction of a permanganate to a manganous salt.

To approach chemistry from the point of view of electron transfer gives a basic unity to the subject. Moreover the gap between elementary physics and chemistry is successfully bridged.

The metallic bond, if viewed as an electron gas, leads readily to the electron flow that constitutes the electric current. The latter, in turn, leads to an easy understanding of electrolysis and ions. Let us hope that the teachers of chemistry and physics of the future will co-ordinate their teaching and present experimental science as a single subject with different branches but resting securely on knowledge of atomic structure.

#### REFERENCES

1. *Chemistry*, 1960, **33** (6), 1.
2. *C.B.A. Newsletter*, 1960, **1** (6), 5.
3. H. G. Deming, *Fundamental Chemistry*, p. 474. New York: John Wiley & Sons, Inc., 1960.



# THE BRITISH CHEMICAL INDUSTRY

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## PART I

The British chemical industry is of unique importance to the economy since its role is largely that of supplier of processed raw materials to the non-chemical sections of industry, thus enabling them to produce the myriad end-products of British manufacturing industry. Having to cater for such varied needs, the chemical industry itself is extraordinarily diverse, particularly as many chemicals are intermediate products, or feedstock, required for the production of other chemicals; thus there is a considerable trade in chemicals even between various establishments within the chemical industry itself.

It is extremely difficult to define the chemical industry, since its boundaries are continually widening and merging with those of related industries—on the one hand with industries supplying it with natural raw materials or with feedstocks, such as the oil-refining industry and the coal-tar distillation industry, and, on the other hand, with industries (e.g. synthetic fibres and plastics) engaged largely in non-chemical operations, since here the chemical products are transformed into articles ready for consumption or not far removed from the end-product itself. Thus Imperial Chemical Industries Ltd takes the manufacture of Terylene through the spinning stage to produce a fibre for delivery to the textile industry; it also coats fabric with plastics, producing leathercloth. Moreover, as an industry is normally taken to be a group of firms whose techniques of production, specialized knowledge and resources are in a

demarcated, rather narrow field, within which a free interchange of productive operations is relatively easy, then the chemical industry—using the term in a somewhat wide sense—is not one industry but many, with as many structures as there are constituent sub-sectors.

The sector that is more obviously 'chemical'—the 'Chemicals (General) Industry,' as classified by the Board of Trade—is thus but the centre of a wider group of chemical industries. The Chemicals (General) Industry comprises establishments (or works) engaged wholly or mainly in the manufacture of acids, alkalis, salts, industrial gases and miscellaneous chemicals. Establishments classified with other trades but nevertheless undertaking important and large-scale chemical operations are excluded, e.g. pharmaceutical, match, plastics, soap and paint. The Board of Trade moreover recognizes a wider grouping as well—the 'Chemical and Allied Trades'—which includes Chemicals (General) as its most important sub-division, employing about one-quarter of the wider trades' personnel. The Association of British Chemical Manufacturers (A.B.C.M.), however, in its *Report on the Chemical Industry*, 1949, adopted an intermediate definition, and the constituent group of trades provided employment for 142,000 persons in 1948, compared with 87,000 persons in the Board of Trade's Chemicals (General) group. As the most comprehensive statistics are published by the Board of Trade, the industry is here taken to consist of the Chemicals and Allied Trades, employing some 400,000 persons in

TABLE I

CHEMICAL AND ALLIED TRADES: PERSONS EMPLOYED: UNITED KINGDOM, 1954  
(Source: Census of Production, 1954)

Trade	Number of employees (000)	Per cent
Coke ovens and by-products .. .. .	20.1	5.0
Dyes and dyestuffs .. .. .	19.8	5.0
Fertilizer .. .. .	21.3	5.3
Coal tar products .. .. .	6.0	1.5
Chemicals (general) .. .. .	91.0	22.8
Drugs and pharmaceutical preparations .. .. .	49.4	12.3
Toilet preparations and perfumery .. .. .	11.7	2.9
Explosives and fireworks .. .. .	40.7	10.1
Paint and varnish .. .. .	38.2	9.5
Soap, candles and glycerine .. .. .	22.1	5.5
Polishes .. .. .	6.1	1.5
Ink .. .. .	4.6	1.1
Match .. .. .	4.2	1.0
Mineral-oil refining .. .. .	16.4	4.0
Oils and greases .. .. .	12.6	3.1
Seed crushing and oil refining .. .. .	8.9	2.2
Glue, gums, paste and allied industries .. .. .	5.3	1.3
Plastics .. .. .	22.1	5.5
Total .. .. .	400.5	100.0



1954. (Including the smaller establishments employing less than 10 persons the total was about 500,000.) Even this wide grouping excludes certain distinctly chemical manufacturing processes, such as the manufacture of man-made fibre materials.

The distribution of employment as between the various trades is given in Table I. Though it is not possible to discuss the structure of such a diverse group of trades, in particular because establishments ostensibly engaged in the same activities seldom produce very similar groupings of products, there are nevertheless many common features that can be examined.

#### DIVERSITY OF PRODUCTS

A striking characteristic of the industry is the great variety of production within it: thousands of different substances are made. Much of this great diversification emanates from the nature of chemical processes, as any one reaction usually gives rise to more than one product. By-products abound in the industry, and every endeavour is made to turn them into a source of revenue; indeed, by-products that were originally waste substances or of minor value have sometimes become of equal or even greater importance than the initial main product. The need to process by-products to obtain saleable substances has frequently been the inducement that has taken firms into productive fields with which they were previously unacquainted. Besides, the growth in production that is a feature of industrial development often results in firms enlarging their range of production so as to ensure continuity and sufficiency of supplies of essential intermediate products previously bought from other manufacturers. The frequent result of the operation of growth and diversification factors is the combining, within one firm, of products and production processes having very little in common with one another. This variety penetrates to individual works or establishments, and as a result many separate establishments, apparently engaged in the same line of manufacture, are found on examination to differ greatly, not only because of differences in techniques and processes for the manufacture of the main chemical products, but also because of the differing assortments of subsidiary manufacturing activities that are undertaken within them.

Research is a potent factor in the diversification of a firm's range of products, and it is apt at times to result in the discovery of entirely new products very different from those previously made. Moreover, since the development of uses for by-products is a matter of insight and inspiration, or, when these functions are placed on an organized basis, of research, it is probably true to rank research as the diversifier *par excellence*.

Innovation, whether the result of inspiration or organized research, has exerted a considerable influence over the growth of firms in the past, and those that have successfully initiated new production processes to satisfy

actual or potential needs have tended to progress more rapidly than other firms, since there are substantial advantages accruing from new products largely unhampered by competition from older products. Moreover, since innovation almost invariably requires capital, the larger firms are better placed than the smaller, and the growth conditioned by innovation usually makes further innovation and growth possible. However, because research sometimes appears to take random turnings, its favours have not always been conferred on the same firm, so that progress has been uneven, with first one firm forging ahead and then another. In time this process, assisted by the merger movement, has resulted in a great diversity in the sizes of firms, some becoming exceptionally large.

#### ECONOMIES OF SCALE; SIZES OF FIRMS AND ESTABLISHMENTS

Chemical processes, to a greater degree than most other production processes, become more economical when operated on a large scale. This is because the substances involved, whether they be gases, liquids or crushed or finely-divided solids, are amenable to handling in relatively simple vessels. Increase in the scale of production is, therefore, largely a matter of increasing the capacity of pipes and vessels, and for geometrical reasons there is an economy resulting from large dimensions, the capital cost of chemical plants increasing much more slowly than the scale of output. Indeed, on the basis of some years' experience of the chemical industry, R. B. Peacock<sup>1</sup> estimates that the capital cost per unit of output falls to a quarter for a tenfold increase in capacity.

Such remarkable falls in capital cost are mainly a feature of continuous-process plants, those operating on the batch principle offering less scope for such economies. In a continuous-flow process all items of plant are in constant use, so that capacity per unit of output can be smaller than with items intermittently employed in batch processes of the same total output.

Costs of operation also fall as output is increased. For example, the lower ratio of surface area to volume as size increases results in smaller heat losses. Again, in large vessels it is easier to maintain uniform conditions and to secure a more uniform product. The labour costs of operation also fall, particularly in continuous-process plants, where there is little manual handling of materials and usually much instrumentation and control equipment. Nowadays instrumentation may account for 10 per cent or more of the cost of a chemical plant. Peacock has suggested that a tenfold magnification of output results in a reduction of approximately five-sixths in unit conversion costs (*i.e.* operating cost, net of materials and essential power).

Continuous-flow methods of production were developed early in the history of the chemical industry—



the lead chamber process for sulphuric acid manufacture, and the Solvay process for the manufacture of soda, for example, became continuous at an early date. More complicated chemical processes, and processes for the manufacture of relatively small quantities of chemicals, such as dyes, are however carried on by batch production methods, the same equipment being used for the production of many different substances. The development of highly instrumented continuous-flow plants has been a feature of recent years, with phenomenal increases in both output and productivity. Because of the economies that large dimensions can secure, it is natural that the industry should be highly capitalized. It has been estimated (Table II, column 1) that at 1955 prices the chemical and allied trades had assets of about £4,300 per person employed, a value considerably higher than that of any other industry. It was, in fact, more than 50 per cent greater than the next highest, £2,800, obtaining in both the metal manu-

facturing and textile industries; double that in the food, drink and tobacco industry group; and six times that of the lowest, the leather, fur and clothing trade.

The degree of concentration of capital in the industry is increasing. In 1948-58, when the labour force of the chemical and allied industries (including mineral-oil refining) amounted to only 5.5 per cent of that of manufacturing industry as a whole, capital expenditure increased from 12 to 21 per cent of the total expenditure of manufacturing industry. In 1953, when the large mineral-oil refinery construction programme was under way, the proportion reached nearly 23 per cent. This growth in concentration may be judged from Table III, which gives figures for selected years within the period. In 1954 the capital expenditure of £244 per person employed in the chemical and allied trades was the highest of all the industrial groups (Table II).

The high degree of mechanization and automation in chemical plants, particularly in the newer ones, is

TABLE II

SELECTED STATISTICS RELATING TO THE MAIN INDUSTRY GROUPS: UNITED KINGDOM, 1954

Industry	Replacement cost new of fixed assets in manufacturing mid-1955	1954 Capital expenditure less disposals per person employed £	1954 Electricity consumption per 1,000 operatives (10 <sup>3</sup> MW)	1954 Net output per person employed £
Treatment of non-metalliferous mining products				
other than coal .. .. .	1,370	76.1	9.1	791
Chemicals and allied trades .. .. .	4,330	243.6	25.6	1,320
Metal manufacture .. .. .	2,790	146.7	15.7	974
Engineering, shipbuilding, electrical goods .. .. .	1,280	50.6	2.8	783
Vehicles .. .. .	1,600	50.8	3.3	813
Metal goods, not elsewhere specified .. .. .	1,100	51.2	3.6	745
Precision instruments, jewellery, etc. .. .. .		40.3	2.0	792
Textiles .. .. .		56.7	3.6	658
Leather, leather goods, fur .. .. .	700	32.5	2.2	678
Clothing, etc. .. .. .		13.7	0.6	483
Food, drink, tobacco .. .. .		91.3	3.7	963
Manufactures of wood and cork .. .. .	900	36.8	2.4	670
Manufactures of paper .. .. .	2,210	75.4	8.1	907
Other manufacturing .. .. .	1,550	59.1	5.8	769
All industry groups .. .. .	1,830	71.0	5.8	808

Sources: Cols. (2)-(4). Census of Production, 1954.

Col. (1). T. Barna, 'The Replacement Cost of Fixed Assets in British Manufacturing Industry in 1955,' *J.R. statist. Soc.*, 1957 (1), 16, Table 3.

TABLE III

GROSS FIXED CAPITAL FORMATION IN MANUFACTURING INDUSTRY AND IN THE CHEMICAL AND ALLIED INDUSTRIES

(Source: Central Statistical Office, *National Income and Expenditure*, 1959, Table 53)

	£ m.			Percentage		
	1948	1953	1958	1948	1953	1958
Chemical and allied industries group ..	40	125	190	12.18	22.85	21.20
Mineral-oil refining .. .. .	6	33	36	1.83	6.03	4.03
Other chemical and allied industries ..	34	92	154	10.35	16.80	17.20
All manufacturing industry .. .. .	328	547	895	100.0	100.0	100.0



reflected in the industry's electricity consumption which, per operative, is almost twice that of the next closest rival, metal manufacturing, and five times the average for British manufacturing industry as a whole.

In addition to the economies that accrue from increasing the scale of an individual chemical plant, there are others, external to the plant itself, that arise from the communal provision of services such as steam, electricity and compressed air to a number of separate but closely adjacent production units. Transport and handling costs are also considerably reduced when, as so often happens, the product of one plant becomes the raw material for the next. Because of the advantages of integration some chemical works are extremely large. The new Wilton works of I.C.I. are probably the most highly integrated in the country, and it is proposed to develop the Severnside site along similar lines.

In 1954, the most recent date for which detailed statistics for the chemical and allied trades are available, there were over 2,000 establishments employing more than 10 persons each, besides many smaller establishments. Only 159 establishments employed 500 or more persons (7.3 per cent of the total number of establishments); they produced over half (56 per cent) of the total net output and employed 53 per cent of the labour force. The 20 largest establishments each employ more than 2,000 persons and altogether employ 80,000 persons (20.4 per cent of the labour force) and produce 20.8 per cent of the net output. In Table V, column 2, the average size of establishment in a number of the chemical trades is given.

Some of the firms are very large. Table V (column 1) gives data on the average size of business units, measured by the number of persons employed, in 1951.

There appears to be considerably greater inequality in the size of firm than in the size of chemical works. The main information on the size-distribution of firms has been given by the A.B.C.M. and relates to 1948, but the general pattern is probably unchanged.

The six largest firms in the distinctly chemical group, as defined by the A.B.C.M., employed 90,000 persons (64 per cent of the total personnel), whereas the 18 largest firms (7 per cent of the total) had more than 75 per cent of the total number of employees (Table VI). A relatively small number of firms, therefore, produce the bulk of the output of chemicals. The majority of firms had 25–499 employees, but some firms were very small.

Table V (column 3) also gives the size-ratio of units or, in other words, the average size of the three largest firms in relation to the average size of the others. These statistics relate to 1951 and they have only very recently been made available.<sup>2</sup> In the case of the chemicals (general) trade<sup>3</sup> this ratio was 90, a value exceeded by one trade only out of the 219 trades for which figures were given, namely bread and flour confectionery. The ratio is very high, mainly because of the size of I.C.I.—

the largest of all British firms in terms of assets/employment that confines its main activities within the country.

The co-existence of small firms alongside the large was also a feature of the other trades in the chemical group in 1951. In the chemical and allied trades<sup>4</sup> the three largest firms together employed 51 per cent of the labour force and produced 46 per cent of the net output, but there was also marked concentration in the constituent industries, the three largest firms employing, on a weighted average basis, 29 per cent of the labour force and producing 33 per cent of the net output. Thus the three largest firms in mineral-oil refining, in soap and glycerine manufacture and in plastics manufacture, out of totals of 8, 113 and 51 firms, respectively, employed 84, 70 and 54 per cent of the labour force. In the chemicals (general) trade the four largest of the 307 firms employed 49 per cent of the trade's labour. In the toilet preparations and perfumery trade, with 77 firms, 35 per cent of the employment was in the largest three firms. Concentration was appreciably lower in both the drugs and pharmaceutical preparations trade and the paints and varnishes trade, with the three largest firms (out of 232 and 296 firms) employing 27 and 19 per cent, respectively, of the trades' labour forces. In the pharmaceutical chemicals section of the pharmaceutical industry the three largest firms, out of 18 in the section, employed 64 per cent of the labour and produced 66 per cent of both the gross and the net output. In the pharmaceutical preparations section the concentration among the three largest firms was as little as 23 per cent for labour, and 21 and 19 per cent for gross output and net output, respectively.

There are considerable differences between the various sections of the chemical industry in the average size of both the firms and the establishments (Table V). The largest firms in the industry not only own more establishments but naturally theirs are the largest establishments—in mineral-oil refining the average firm employs 1,500 persons, with an average of 800 persons per refinery; at the other end of the scale comes the paint and varnish industry, with an average of 120 employees per firm and of 100 per establishment. The last column of Table V shows the average size of the establishments of the three largest firms in a sector of the industry in relation to the average size of all other establishments in the sector in 1951. In the chemicals (general) group, for example, the establishments of the three largest firms were more than five times as large, on average, as the establishments of other firms. The size ratio was more than double this in match-making and in the soap and glycerine trades, and almost double in toilet preparations and perfumery manufacture, and appreciably higher in the drugs and pharmaceutical preparations trade. In coke ovens and by-products the ratio is smaller than unity, indicating (in conjunction with the figures in column 4) that the larger firms (which between them employ 63 per cent of the labour force)



have their large output mainly because of plant duplication rather than as a result of the large size of their individual plants (or establishments), although, of course, these large business units own larger as well as smaller establishments. Indeed, as we see in column 4, the three largest firms in the coke ovens and by-products trade have nearly 17 plants for every one owned by the

other firms. This multiplicity of plants is a consequence of the whittling away of the economies of large-scale production mainly by heavy transport costs on the raw material, and by the high costs that would be borne by the finished products if produced in few establishments with relatively long hauls to consumers.

In the chemicals (general) trade the number ratio of

TABLE IV

CHEMICALS AND ALLIED TRADES  
SIZE-DISTRIBUTION OF ESTABLISHMENTS, EMPLOYMENT, GROSS OUTPUT, NET OUTPUT AND NET OUTPUT PER PERSON EMPLOYED  
UNITED KINGDOM, 1954

Size of establishment (average number employed)	Number of establishments	Gross output	Net output	Total employment (number)	Net output per person £
11-24	508	33,317	10,010	9,091	1,100
25-49	507	61,755	19,770	18,110	1,090
50-99	414	102,315	34,118	29,237	1,170
100-199	333	175,231	57,176	46,910	1,210
200-299	134	136,084	40,778	32,032	1,270
300-399	76	112,540	37,897	26,586	1,430
400-499	46	93,657	28,685	21,122	1,350
500-749	66	170,149	58,305	40,148	1,450
750-999	29	107,443	33,394	25,343	1,310
1,000-1,499	28	177,983	50,692	32,776	1,540
1,500-1,999	16	120,901	36,338	28,075	1,290
2,000-2,999	7	164,512	35,711	18,614	1,920
3,000 and over	13	191,479	71,279	61,355	1,160
	2,177	1,647,367	514,126	389,399	1,320

(Source: Census of Production, 1954)

TABLE V

AVERAGE SIZE OF FIRMS<sup>1</sup> AND ESTABLISHMENTS, SIZE-RATIO OF FIRMS AND NUMBER- AND SIZE-RATIOS OF ESTABLISHMENTS, 1951  
(Selected trades within the Chemical and Allied Trades group)

Trade <sup>2</sup>	Average size of firms (000s)	Average size of establishments (000s)	Size ratio of firms	Number ratio of establishments	Size ratio of establishments
<i>High Concentration</i>					
Mineral-oil refining <sup>3</sup> .. .. .	1.52	0.81	8	2.5	3.5
Seed crushing .. .. .	0.35	0.19	34	5.6	6.0
Match .. .. .	0.15	0.12	33	2.8	11.6
Fertilizers .. .. .	0.24	0.14	59	14.3	4.1
Soap and glycerine .. .. .	0.25	0.21	62	4.9	12.7
Explosives and fireworks .. .. .	1.05	0.52	70	10.3	6.8
<i>Medium Concentration</i>					
Glue, gum, paste, etc. .. .. .	0.10	0.09	10	2.7	3.8
Coke ovens and by-products .. .. .	0.78	0.22	12	16.8	0.7
Lubricating oils and greases .. .. .	0.09	0.07	13	2.8	4.6
Toilet preparations and perfumery .. .. .	0.13	0.13	13	1.3	10.3
Plastics materials .. .. .	0.40	0.30	18	3.8	4.8
Chemicals (general) .. .. .	0.28	0.18	90	16.7	5.4
<i>Low Concentration</i>					
Paint and varnish .. .. .	0.12	0.10	23	5.7	4.1
Drugs and pharmaceutical preparations .. .. .	0.22	0.18	28	3.3	8.5

<sup>1</sup> Strictly 'business units.'

<sup>2</sup> The degree of concentration is given (by Evelyn and Little) as the employment (or net output) of the three largest business units expressed as a proportion of the total for the trade: High = 67 per cent and over; Medium = 34-66 per cent; and Low = 33 per cent and under.

<sup>3</sup> In 1958 the average size of firm and of establishment in this industry was 2,170 and 1,085 respectively.

(Source: R. Evelyn and I. M. D. Little, *Concentration in British Industry*, Cambridge University Press, 1960. Appendix H.)



TABLE VI  
SIZE-DISTRIBUTION OF CHEMICAL FIRMS, 1948

Size of firm (number of employees)	Number of firms	Number of employees in such firms	Percentage of total	
			By firms	By employees
0-10	31	206	11.5	0.15
11-24	49	861	18.3	0.61
25-99	89	4,748	33.2	3.35
100-499	61	13,711	22.8	9.70
500-999	20	13,832	7.5	9.70
1,000-1,999	12	17,891	4.5	12.60
2,000 and over	6	90,568	2.2	63.90
Total .. ..	268	141,817	100.0	100.0

(Source : Association of British Chemical Manufacturers, *Report on the Chemical Industry, 1949.*)

establishments is also nearly 17, but unlike the coke ovens and by-products industry, the size ratio of establishments is moderately large, namely 5.4. In this section, therefore, there is usually a high degree of specialization with many products manufactured on a relatively large scale; but to cover the wide range of products produced by these firms, many establishments are necessary.

Net output per head, as we see in Table IV, which gives figures for 1954, is on the whole larger in the larger establishments. This is to be expected since, in general, the amount of capital employed in conjunction with a given amount of labour increases with the size of establishment, and so the effectiveness of labour is increased. However, there is not a completely steady variation with size. This may be partly the result of product diversification which, by limiting the scope for achieving economies of large-scale production, is a factor which can cause the productivity figures of large establishments to be lower than those of smaller, less diversified, establishments. Another factor is advertising: this is a productive activity which, although carried on outside the chemical industry, adds to its production and has to be remunerated from net output. Thus a higher net output per head in some size groups than in others does not necessarily signify a higher production per employee within those groups, since specialist activities carried on by outside agencies may sometimes be creating value on behalf of the industry. Advertising plays an important part in the toilet preparations and perfumery trade, the publicly advertised proprietaries or patent medicine section of the drugs and pharmaceutical preparations trade, and in the paint and varnish trade.

#### INTER-FIRM RELATIONSHIPS, CONCENTRATION OF PRODUCTION, MONOPOLY AND COMPETITION

Since so many products of the chemical industry are intermediates, used in the production of other chemicals, there is a complex flow of feedstock and intermediate products between firms and between the different works of the larger firms. Such a complex flow of materials

within the industry makes inter-firm relationships unusually important. I.C.I., which produces some 40 per cent of the industry's output, mainly in the fields of dyes, fertilizers, disinfectants, coal-tar products, general chemicals, explosives and plastics, is in a position of pre-eminence. A large proportion of its output is sold to other chemical firms who use the products as raw materials in various other chemical operations carried out by them. I.C.I. is usually a leading producer of the intermediate chemicals it makes, and sometimes it is the sole producer (of soda ash for example). Yet, despite its size, I.C.I. produces less than 10 per cent of the 8,000 or so chemicals produced by the chemicals (general) industry. Naturally among this total there are products of greatly differing importance, their total output varying very widely from a few lb to thousands of tons. I.C.I. itself is also a large purchaser of many of the 7,000 or so chemical products which it does not produce but which it uses in the production of other chemicals. The other large firms are much more specialized than I.C.I. and they tend to confine their activities to a small number of broad sectors. The Distillers Co. Ltd and Monsanto Ltd are leading producers in three of the seven main sectors of the chemical group. Fisons Ltd has an interest in three sectors while the other firms in the industry are for the most part almost exclusively interested in one broad sector.

Small firms exist alongside the giants, as we have seen, and some of these small firms are nevertheless sole—or monopolist—producers of certain chemicals. However, the extent of monopoly power, which manifests itself as the ability to control the output or price of a particular chemical, does not appear to be great. Because of the great degree of product diversity in the industry, figures giving the concentration of employment and value of output among the larger firms afford little indication of the extent of monopoly power exercised or potentially exercisable in the industry, or for that matter where such power would necessarily reside. Firms are often monopolists in certain fields of production solely because highly specialized expertise is required or in



other instances because the total quantities of the product demanded are small. Firms that are monopolist producers of unpatented chemicals usually pursue a very moderate pricing policy, since they generally sell to other chemical firms, and these latter are usually aware of their vulnerability to monopolist exploitation; any suspicion that a certain product is too highly priced is enough to induce these firms to produce it for themselves. In this field, therefore, the power of informed buyers is the main safeguard against monopolist exploitation. The fact that there is monopolist production is a consequence of the economies of scale, a potential producer being hesitant about entering a field where total demand for the product is low, since the scale of his output would be lower than that of the established producer, with the possibility that the cost of production could well exceed the present selling price.

With such a high degree of interdependence between the members of the industry, and with a firm such as I.C.I. depending on the small and moderate concerns to purchase its products, and I.C.I. in turn so dependent on the rest of the industry for supplies of certain essential intermediate chemicals, the economic well-being of the chemical industry as a whole is a matter of mutual concern. As a result, certain of the basic chemicals, in particular sulphuric acid and alkalis, required as process agents by many of the firms, most of them too small to contemplate production on their own, are supplied as service products, at prices which are moderate and constant over a prolonged period, often under long-term contracts. Users are so dependent on assured supplies that there is considerable allegiance to individual suppliers, and they seldom endeavour to secure a temporary advantage, even if the opportunity to switch over to a cheaper source of supply presents itself. I.C.I. supplies all British industry's requirements of alkali (except for a very small amount of caustic soda), and quite a large proportion of the sulphuric acid. Indeed, sulphuric acid production is not regarded as a very profitable line by I.C.I. and so it encourages its customers not only to set up their own plants but to supply neighbouring small consumers as well.

Price competition in the industry is thus considerably blunted so that different consumers often buy intermediate products at different prices. However, such differences must necessarily be small since long-term contracts come up for revision in due course and a consumer who becomes free of contractual obligations after consistently receiving less favourable terms will change his allegiance. Despite the dulled edge of competition the prices of chemicals generally have a downward trend relatively to other prices: this is because technical progress results in a lowering of production costs and good neighbourship and pride in technical achievement appear to be sufficient reasons for passing some of the benefits forward to consumers. Another consequence of the inseverity of competition is the tendency to sell in

the export market at prices below those in the home market: producers prefer to do this rather than to upset an existing customer in the home market by selling to his competitor at home at a lower price.

#### RESEARCH

The industry is firmly rooted in the science of chemistry, developments in which can often lead to beneficial modifications of production methods or to entirely new products for which a great demand may arise. Considerable advantages can accrue from the application of scientific knowledge and so, in a competitive economy, it behoves all concerned to be alert to the benefits that scientific developments can bring. Research is the means by which scientific developments can be turned into industrial progress and so it is an important activity in the chemical industry.

Research is expensive. For example, it has been estimated that in the chemicals and allied trades in 1958, research and development cost over £6,500 per qualified worker. In mineral-oil refining<sup>5</sup> it was nearly £10,000. Because of this high cost, and because there are decided benefits of scale in research, it is only the larger firms that can afford to undertake research on a significant scale, and they do so only because they generally reap benefits more than in proportion to the cost. The rate at which firms grow in this industry is greatly influenced by the amount of research that they do.

In 1958 expenditure on research in the chemical group of industries<sup>6</sup> amounted to £43 m., about one-half of this being in the distinctly chemical core. Some 6,400 qualified persons were employed<sup>7</sup> on research in the whole group of trades, a larger number than in any other industry except electrical engineering and electrical goods. Costs per qualified research worker were considerably higher in several other industries than in the chemical group (aircraft £31,000, motor vehicles £20,000, precision instruments £14,000 and man-made fibres £11,000, to cite a few) and so as a result several industries were spending a higher proportion of their net output on research than the chemical. The aircraft industry devotes an amount equal to 35 per cent of the value of its net output to research,<sup>8</sup> the electrical engineering and electrical goods industry 12 per cent, precision instruments 11 per cent, with the chemical group next, spending 6 per cent—this nevertheless being half as large again as the average for British manufacturing industry as a whole. The ratios in electrical engineering and aircraft are very high because of large defence contracts for research and development, 80 per cent by value of all defence contracts being placed in these two industries.

The research effort is very unevenly distributed over the various sections of the chemical group and between the various firms. Half the research effort, £22 m. or so,<sup>9</sup> is in the chemical core,<sup>10</sup> a sixth (£7 m.) in mineral-oil refining and an eighth in the pharmaceutical



industry.<sup>11</sup> I.C.I. undertakes research on a large scale, accounting for more than half the research expenditure of the chemicals (general) group; in 1959, for example,<sup>12</sup> expenditure on research and development (including technical services) was £14 m. The Distillers Company and Monsanto also carry out research on a large scale, and the latter can benefit from the research carried out by the parent company in the United States.

Nearly all the chemical group's expenditure of £43 m. on research and development is incurred in its own establishments, a bare 1½ per cent being used to finance research (connected with the firms' production activities) in universities and technical colleges, co-operative and other research institutions. The figure of £43 m., however, is exclusive of contributions to fundamental research in universities by the establishment of research fellowships and supporting research funds.<sup>13</sup>

1. R. B. Peacock, 'The Assessment of a Project in the Heavy Chemical Industry,' *Accounting Research*, 1954, 5 (4), 275.
2. R. Evelyn and I. M. D. Little, *Concentration in British Industry*. Cambridge University Press, 1960. Instead of using the word 'firm' Evelyn and Little refer to a 'business unit' which is defined as a single firm, or aggregate of firms owned or controlled by a single parent company, control being defined as ownership of more than half the capital (or voting power) of each firm.
3. According to the Standard Industrial classification used in Board of Trade and other official statistics.
4. Actually the figures given by Evelyn and Little (*op. cit.*) relate to 16 main trades within the chemical and allied trades group which together accounted for 89 per cent of the total employment of the group as a whole.
5. Department of Scientific and Industrial Research, *Industrial Research and Development Expenditure, 1958*. H.M. Stationery Office, 1960. Table I.
6. *Ibid.*, Table II.
7. *Ibid.*, Table I.
8. *Ibid.*, Table III.
9. Sir William Garrett, in *Financial Times Review of the Chemical Industry*, 1959.
10. The A.B.C.M. group.
11. In the pharmaceutical industry, according to E. D. Carey (*Financial Times Review of the Chemical Industry*, 1959) research expenditure in 1959 amounted to approximately £5 m.
12. I.C.I. *Annual Report*, 1959, p. 14. Some of this research expenditure will, of course, be outside the chemicals (general) industry.
13. D.S.I.R. Report, ref. 5, Table V.

### THE HARRISON MEMORIAL PRIZE

The Harrison Memorial Prize for 1959 has been awarded to Dr D. A. Buckingham in consideration of his research work in the field of physical chemistry, and especially on account of his theoretical contributions to the understanding of solvent effects upon molecular spectra and to the theory of pressure-induced spectra. Dr Buckingham is a graduate of the University of Sydney. After a period of postgraduate research at Cambridge, he took up an appointment at Oxford, where he is now a Demonstrator and Lecturer in inorganic chemistry and a Student of Christ Church.

## Book Reviews

CHEMICAL PERIODICITY. R. T. Sanderson. Pp. x + 330. *New York: Reinhold Publishing Corporation; London: Chapman & Hall Ltd*, 1960. 94s.

This is one of the most novel textbooks on inorganic chemistry to appear in recent years. It is difficult to forecast whether it will eventually prove more popular as a student textbook or as an aid to the teacher of chemistry, but for readers of either category it is an interesting and stimulating volume. As Professor Sisler points out in the Foreword, there should always exist a willingness to try new approaches in the study of inorganic chemistry, and this book certainly attempts a fresh presentation of subject matter. The Periodic Table in the 'long form' is taken as the essential foundation for systematic thinking, and the physical and chemical properties of the elements are correlated on this basis. The difficulties in the teaching and study of inorganic chemistry arise from the need to relate compounds one with another in a logical system; without this the subject can so easily degenerate into a mass of disconnected facts. Even when the Periodic Table is accepted as the essential framework, different approaches are possible, and there are two extreme cases. Firstly, one can consider together all the compounds formed by elements of one Group, which does not bring out the comparisons of one Group with another. Secondly, one can take particular compound types (for example, the chlorides) and trace the variation of their properties across the Periodic Table. This emphasizes chemical periodicity, but makes it more difficult to present a general picture of the chemistry of any particular Group. The first method is the one commonly used in inorganic textbooks; this book is a serious attempt to put forward the advantages of the second approach, and deals predominantly with the chemistry of the non-metals in their binary compounds. This imposes obvious limitations as to the compounds that can be included but it has enabled the author to illustrate periodicity to a much greater extent than has hitherto been attempted in a textbook.

The book is written in the belief that as well as providing the framework for the written data, the Periodic Table can be used to give a visual impression of the variation in any property throughout the Table, and one of the main attractions of the book lies in the use of periodic charts. Altogether 63 charts of the Periodic Table are given, in each of which one physical or chemical property is displayed, the magnitude of the property being represented by circles of different sizes. By this means the overall variations can certainly be seen at a glance. For example, the physical natures of the elements themselves are surveyed in Chapter 5, which includes 11 charts dealing with heats of formation, states of aggregation, densities, atomic volumes, melting points



and boiling points, heats of vaporization and fusion, electrical conductivity, atomic conductivity and thermal conductivity. Although a considerable amount of factual information is presented (in 206 tables and 83 figures), the book is much more than a compilation of data. The chemistry involved in each chapter is discussed in a clear, readable manner, and is obviously written by an experienced teacher. The author is already well known for his contributions to the theory of electronegativity and stability ratios; every attempt is made to interpret periodicity effects and apparent anomalies, though some of these interpretations are necessarily speculative. Mention should also be made of the attention given to the structure of molecules. The book contains 51 plates showing molecular models.

There are 17 chapters; four introductory chapters deal with the fundamental basis of the periodic law, chemical combination, the condition of combined atoms and the elementary principles of co-ordination chemistry. This is followed by nine chapters dealing with complex oxides and the binary compounds of oxygen, hydrogen, nitrogen, sulphur, fluorine, chlorine, bromine and iodine. A further chapter compares the methyl, ethyl and phenyl compounds of the elements, and there is a brief reference to the inner transition elements and the periodicity of co-ordination chemistry. Each chapter concludes with a list of questions for review, questions for further thought and supplementary references.

The book is very well printed, produced and indexed; the price of 94s. is high for a book of 324 pages, but this is perhaps not too unreasonable in view of the high-quality printing called for by the charts and plates.

C. C. ADDISON

#### RECENT PROGRESS IN HORMONE RESEARCH.

VOLUME XVI. Proceedings of the Laurentian Hormone Conference, 1959. Edited by G. Pincus. Pp. viii + 608. *New York: Academic Press Inc.*; *London: Academic Books Ltd*, 1960. \$14, 112s.

The chemistry and biochemistry of the hormones have progressed substantially since Bayliss and Starling first coined the word 'hormone' nearly 60 years ago, yet our knowledge of how these important substances exert their profound effects is still shrouded in mystery. It is fitting, therefore, that the first part of the Laurentian Hormone Conference, of which this book is a record, should be devoted to this subject. This is especially so since it seemed possible a short while ago that the action of a number of steroids might be explained in terms of an oxidation-reduction mechanism, the steroid acting as a coenzyme in a transhydrogenase responsible for transferring hydrogen from triphosphopyridine nucleotide to diphosphopyridine nucleotide. The proportions of these two coenzyme compounds in their reduced forms can play a part in directing metabolic pathways. The interested reader will find current views critically examined by the various proponents. Engel and Scott

have presented an excellent paper suggesting an action of corticosterone on glutamic acid dehydrogenase which could make available additional amounts of intermediates for the Krebs cycle and thus lead to increased glycogen synthesis, a known physiological effect of the hormone. It has long been maintained that insulin exerts its action by increasing the permeability of the cell membrane to glucose, and recently such a permeability mechanism has been extended to the action of ACTH. Hechter and Lester have produced evidence that deoxycorticosterone modifies cation transport in *Neurospora*, and, in a masterly review, have put this cell-permeability theory on modern concepts of cell and membrane structure. They have considered how the cell membrane could be linked to the intracellular enzymes known to be spatially arranged within the cell, and suggest that a hormone may act by altering the units of a charged-lattice system throughout the cell.

I have laid stress on the first part of the Conference, because of the importance of the subject, hitherto not well summarized; but the remainder of the book also has much of interest. The second part is concerned with the peptide hormones, and the paper by Read and Bryan describes a revolutionary method of estimating growth hormone which makes use of the extreme sensitivity of antibodies in the serum of animals which have been injected with the hormone. The antibody-containing serum provides an amazingly sensitive reagent for the detection of minute quantities of the hormone. Read's approach is a model of the preliminary work such a method demands before it can be accepted as providing a legitimate assay. Other papers in this section deal with haemopoietin, the hormone secreted by the anterior pituitary gland responsible for controlling blood formation, and other biologically active polypeptides are discussed by Croxatto and Barnafi of Chile. The third part of the Conference brings up to date our knowledge of the thyroid hormones. In the final part, which is concerned with hormones and metabolism, Wertheimer and Shafir discuss the effect of hormones on fat, which is now known as a highly metabolically active tissue and not just a dumping ground for spare calories. The last contribution deals with the effect of hormones on alternative pathways of glucose utilization in isolated tissues.

This volume maintains the interest and high standard of previous volumes.

C. H. GRAY

ADVANCES IN ORGANIC CHEMISTRY. METHODS AND RESULTS. VOLUME II. Edited by R. A. Raphael, E. C. Taylor and Hans Wynberg. Pp. vii + 504. *New York: Interscience Publishers, Inc.*; *London: Interscience Publishers Ltd*, 1960. 113s.

The appearance of the second volume of this valuable series so soon after the first (*see J.*, 1960, 211) is a tribute to the editors and publishers, and it is all the more



pleasing to find that the high standard of the first is being fully maintained. The general pattern remains the same: three general editors and a team of international experts who contribute one chapter each on a topic on which they are acknowledged authorities. Two of the chapters have been translated into English from the originals but the translations are good and eminently readable. There are eight contributions in all, beginning with a chapter by H. Normant (Paris) on the preparation and application of alkenyl Grignard derivatives. This is very thorough, although it is a pity that a more detailed treatment of the corresponding lithium derivatives (Braude *et al.*) could not have been included. There follows an account of the dialkoxy- and diacyloxy-dihydrofurans, which, in many reactions, are protected derivatives of the 2-ethylenic-1,4-diketones. Their preparation and reactions, studied so extensively by the author and Dr Clauson-Kaas in Copenhagen, are detailed, including their conversion to several of the tropane alkaloids and to vitamin B<sub>6</sub>. The longest chapter in the book deals with the preparation and reactions of the ethynyl ethers and thioethers, and in particular their use for the synthesis of  $\alpha\beta$ -unsaturated aldehydes and esters. It will be recalled that it was the use of ethoxycetylene which was the key step in the first vitamin A synthesis in 1946, carried out by Professor Arens, the author of this chapter. In contrast to reagents of fairly recent introduction, ketene has a long-established tradition in organic synthesis as well as the organic chemical industry. R. N. Lacey is well acquainted with both these aspects of ketene chemistry and his contribution on this topic, augmented by accounts of the related substances, diketene, isopropenyl acetate and  $\beta$ -propiolactone, is authoritative and complete. The next three chapters deal with methods rather than reagents. An account of the theory and applications of nuclear magnetic resonance is especially timely, even though a number of other reviews exist. H. Conroy provides an excellent chapter, and the section on specific examples is as up to date as could be expected. L. M. Jackman and P. De Mayo, contemporaries at Imperial College, provide excellent accounts of hydrogenation-dehydrogenation reactions and the ultra-violet photochemistry of simple unsaturated systems, respectively. The final chapter by C. H. Eugster deals with the structure determination and synthesis of the alkaloid muscarine, a substance of extraordinary chemical interest. Many of the chapters contain full experimental details for relevant compounds, and all are completely documented by ample reference to the original literature, much of it as recent as 1959, and with occasional references to unpublished work which is only now appearing in the journals. The book as a whole is a wealth of chemical information and is thoroughly to be recommended in spite of the formidable price.

A. W. JOHNSON

BIOCHEMISTRY OF LIPIDS. (Proceedings of the Fifth International Conference on the Biochemical Problems of Lipids held at the Fourth International Congress of Biochemistry, Vienna 1958.) Edited by G. Popjak. Pp. xi + 228. Oxford: Pergamon Press Ltd, 1960. 40s.

This conference differed from the preceding International Colloquia, which had been limited to particular aspects of the biochemistry of lipids. As a result, the book consists of 54 papers, which in the words of the Editor 'bear witness to the varied research projects in the field of lipid biochemistry conducted all over the world.' It is indeed a cosmopolitan collection of contributors, who reveal something of the diversity of problems in this field. Some are concerned with the application of recently developed biochemical techniques to the separation and analysis of lipid fractions. The biosynthesis of cholesterol receives considerable attention, as do the uses of diets deficient in particular lipids, or supplemented by them. A number of papers contain reports of work on the intermediate metabolism of certain groups of lipids and on the purification, estimation and action of enzymes. Medical implications of some current lipid research appear in its relation to atherosclerosis. Many papers do not permit of any grouping, feeling out into diverse branches of lipid biochemistry.

Over one-third of the contributions are presented in abstract form only. If the work has been published elsewhere since the Congress, it is reported here as an abstract, giving the reference to the detailed account. Other abstracts have resulted from the reluctance of authors either to have their papers published or to reply to letters from the Scientific Editor. This is unfortunate, as it detracts considerably from the value of the volume. The papers and abstracts are published in one of three languages—English, French or German. There is no subject or author index.

This is essentially a book for the specialist and its value will depend on the emphasis given to the reader's particular field of interest. However, it is claimed that much of the information has not been published elsewhere.

R. J. C. BARRY

MOLECULAR DISTILLATION. (Monographs on the Physics and Chemistry of Materials.) G. Burrows. Pp. viii + 214. Clarendon Press: Oxford University Press, 1960. 35s.

In the last two decades the transition of vacuum practice from an academic curiosity to common use in industry has been quite remarkable. In this book the author considers the fundamental principles of vacuum techniques, the application of these principles and the design of industrial equipment in such a way that a physicist, chemist or engineer is helped to appreciate the others' points of view. This, however, means that



parts of the book may be considered to be common knowledge by, say, a physicist but be of particular interest to an engineer. It is written in a manner critical not only of available techniques and equipment, but also of the economics of capital costs versus running costs, and so on.

The book is divided into nine chapters. The first three deal with basic theory; they may be regarded as the 'science of vacuum.' Chapter 4, 'Vacuum Technique,' deals critically with the degree of vacuum required for the process of molecular distillation and the performance of booster, backing and diffusion pumps; an interesting new approach to free and molecular flow is given. The design of vacuum equipment for molecular distillation processes is discussed in Chapter 5, particular attention being given to sources of leakages and the detection of leaks, but perhaps more important are calculations made to illustrate what maximum rise in pressure may be tolerated without influencing the efficiency of the process.

Chapters 6 and 7 deal with the factors that have to be considered in the design of apparatus for processing different solutions, with examples of various degassers and stills. Some practical examples of the molecular distillation in operation are considered in Chapter 8, while Chapter 9 deals with the utilization and scope of the process.

There is a useful appendix and a selective rather than comprehensive list of references. A feature of the book is the manner in which the author has blended fundamental principles with practical applications and copious numerical calculations.

M. W. ROBERTS

SYMPOSIUM ON ELECTRODEPOSITION AND METAL FINISHING. (Proceedings of the Symposium held at Karaikudi, December 27 and 28, 1957.) Pp. xiv + 188. *Bangalore: The India Section, The Electrochemical Society*, 1960. Rs. 15.

Although belated, this publication, which contains the papers presented at Karaikudi in 1957, is none the less welcome as it provides, so to speak, a bird's-eye view of Indian interests in the electrochemical and electrometallurgical spheres. The mixed bag of material composing this volume is evidence of the widespread nature of these interests.

The subject matter varies from laboratory studies of the electrolytic separation of metals (iron, lead, manganese, zinc and so on), which reflect Indian pursuits in electro-winning, to reviews of such electrodeposition processes as bright nickel plating, hard chromium plating and the deposition of nickel alloys, tin/zinc, tin/copper and brass from respective pyrophosphate baths. These pyrophosphate studies appear to be under the direction of J. Vaid and T. L. Ramakhar, from whose laboratory in the Indian Institute of Science, Bangalore, these useful technical contributions have now emanated.

Some interesting claims are made in respect of ease of deposition of nickel alloys from pyrophosphate electrolytes, which are said to 'throw' well and indicate good anode performance. The deposition of nickel alloys with uncommon metals such as manganese, tungsten and molybdenum is also reported and, as suggested by the authors, is certainly 'worth further study,' perhaps by Western laboratories.

The plating of 'uncommon' metals such as titanium, zirconium, ruthenium and even plutonium is referred to by J. Balachandra; however, this appears to be a somewhat superficial review of the subject. Indeed, the standard of the contributions is very uneven and varies from elementary exercises in electrochemistry to useful research studies, not only of electrodeposition but also electropolishing and anodizing. Other articles deal with corrosion phenomena and organic coatings. As regards the former, an interesting estimate of the annual cost of corrosion in India has been made by K. S. Rajagopalan, of the Central Electrochemical Research Institute, Karaikudi; this, surprisingly enough, appears to work out to about one-fifth of that in the U.K.

As will be apparent, the Symposium dealt with a wide range of subjects. Perhaps the most interesting point that emerges from this volume is the evidence of so much activity in the electrochemical field in India. The standard of the publication itself, however, cannot be commended. It is paper-backed; some of the illustrations are reasonably good; others are so poorly reproduced as to be incomprehensible (*e.g.* graphs on p. 97 *et seq.*). Judging from the references at the end of almost every paper, most of the contributors have kept abreast of recent work in the international field, especially Western sources.

S. WERNICK

CHEMICAL ENGINEERING PRACTICE. VOLUME XI. WORKS DESIGN, ETC. Edited by H. W. Cremer and S. B. Watkins. Pp. vi + 390 + XVIII. *London: Butterworths Scientific Publications; New York: Academic Press Inc.*, 1959. 95s.

The present Volume XI follows publication of Volume VI, and is published out of sequence. It covers a number of 'fringe' subjects about which a chemical engineer engaged in industry is usually required to have some knowledge and understanding. The title 'Works Design, etc.' is not a very happy or expressive one, though it is admittedly difficult to think of a better one which would be brief and which would also indicate the range of subjects treated. Of the nine chapters in this volume five come under the 'etc.' of the title and deal with 'works administration,' 'factory legislation,' 'the Alkali Acts,' 'industrial hazards' and 'patents.'

The first four chapters, under the general heading 'Works Design, Layout and Execution,' would be more in place in an encyclopaedia of general engineering or

civil engineering; in many respects they fail to consider the particular conditions of the chemical and process industries. A few examples may be cited. Discussion of the number of 'machines' to be installed for each process operation and the positioning of such 'machines' (p. 4) suggests that the author's mind is on mechanical production rather than on chemical production. The ideal plant layout is pictured as one with straight-through flow from raw material to finished product. No reference is made to the cases—of frequent occurrence in chemical processes—where extensive recycling is necessary, or an intermediate product may be converted into several different finished products in separate plants. In discussing the factors to be considered when choosing a site for a new plant, no mention is made of the flexibility of choice that can be introduced in those cases where pipelines can be used for the transport of raw materials or products over considerable distances. Many modern chemical plants are built in the open—and for very good reasons. The only reference to this important type of construction is the statement (p. 75) that 'plants may also be designed to operate in the open air, but a more normal factory plant. . . .' The chapter on 'contracts and contract documents' is essentially confined to civil engineering work and buildings; there is no discussion of contracts for chemical plant, and chemical plant manufacturers are not even mentioned among the various types of specialist sub-contractors listed on p. 57.

In marked contrast to the chapters on 'works design,' the other chapters have a definite chemical engineering 'slant.' For instance, the one on 'works administration' points out that 'the principles underlying the technique of modern management are all applicable to the chemical industry but their application requires a different emphasis' (p. 83). This chapter gives a very lucid and readable account of basic principles and is refreshingly free from the obscure verbiage and jargon which characterize so much of what is written on the subject of management and administration. The chapters on 'factory legislation,' 'the Alkali Acts,' 'industrial hazards' and 'patents' are all exceedingly well written. It is no small achievement to take the dull material of Acts of Parliament and Statutory Orders, to enlarge on it and explain it by aptly-selected examples of practical application and to produce a readable and instructive story. In some cases the authors have given a brief historical introduction, which is a valuable feature. In the chapter on the Alkali Acts, when referring to the Clean Air Act, 1956, the author points out that the first chief alkali inspector, writing in 1870 on the possible extension of the Alkali Act, stated that 'Coal smoke may some day be included, especially when people, for economy, burn a very inferior coal.' It only took 86 years for this prophecy to be fulfilled.

The chemical engineer who buys this volume may

well be disappointed with the first four chapters on 'works design,' but he should be adequately rewarded by the remaining five chapters which are collectively described by the humble 'etc.' in the volume title; and let it be emphasized that these five chapters constitute 80 per cent of the text.

A. J. V. UNDERWOOD

A SHORT HISTORY OF TECHNOLOGY FROM THE EARLIEST TIMES TO A.D. 1900. T. K. Derry and T. I. Williams. Pp. xviii + 782. Clarendon Press: Oxford University Press, 1960. 38s.

It gave great pleasure to many that the two senior editors of the five-volume *History of Technology*, the distinguished scholars Charles Singer and E. J. Holmyard, lived to see the completion of what must have been one of the most satisfying ventures of their careers. With this material available, it was hoped and foreseen that a shorter account would be called for. To meet the needs of a wider reading public it was decided to produce a new book, in which technological history would be related to general history, rather than to abridge the large work.

The *Short History* is divided into two parts, each being introduced by a comprehensive 'general historical survey'; the year 1750 has been taken as the dividing line. The first part deals mainly with food, domestic needs, metals, building construction, transport, communication and record, power and the beginnings of the chemical industry. The second part, necessarily longer, has additional themes, including the steam engine, machine tools, coal and new materials like coal-gas, petroleum and rubber, the rise of the 'modern' chemical industry, textiles, the internal combustion engine and the electrical industry.

The obvious choice of author was Dr Trevor Williams, who had been managing editor of the later volumes of the *History*, and Dr Derry was chosen as collaborator. This combination—a scientist and editor with a teacher and economic historian—would seem ideal for the task. Indeed, they have produced what may be fairly described as the first synoptic technological history in the English language—one that will probably evoke as much admiration in literary and historical circles as among scientists and technologists. It will be of value to arts students as an introduction to technology and its fascinating history, and a considerable stimulus to science students. With some 800 pages and more than 350 illustrations it is outstanding value for money, and for this we must in part thank Imperial Chemical Industries Ltd for the financial endowment of the book and of the earlier *History*.

The *Shorter History* is so well constructed, so competently written and so satisfying to read that it is difficult to find points to criticize. Some students may note the rare inconsistencies of spelling, such as 'Mycenean' and 'Mycenaean,' and a tendency to



over-hyphenation, as for example in 'staged-towers' and 'electric-motor.' There are a few abrupt changes of tense, and at least once the search for variety of expression does not quite come off, as when we are told that 'the spoke and the horse made their début together.'

One general observation that should be made is that the *Shorter History* does not correlate developments in technology with advances in science. On reflection, the scientific reader will realize that for much of the period there is little correlation to record, for the story begins with the early civilizations and stops rather suddenly and somewhat artificially at about 1900. Perhaps wisely, the authors even avoid defining technology, although basically it is interpreted as man's attempts to find physical and chemical means of transforming his environment (p. 259 f.). In effect, therefore, it covers all the means of progress in the arts, sciences and manufactures. The authors steer clear of extreme definitions, such as the science behind manufacturing industry, or the ethnological study of developments in the technical arts; but the story begins very close to the latter and gradually becomes an approximation to the former.

Having digested such a vast range of subject matter and surveyed such a large span of time, who are better placed than the authors to continue the story from 1900 to the present day? Doubtless it would require a separate book of almost comparable length. Naturally the reader would require an elementary knowledge of science in order to follow it with profit. Admittedly, we are too close to the events themselves to see them in their 'true' historical significance. Yet to awaken a historical sense in the young and to omit the most essential link in the story—the link with the living present—is to limit the value of such studies. Many will hope that the authors will reconsider their decision to leave the subject at the point they have so successfully reached.

F. W. GIBBS

STYLE GUIDE FOR CHEMISTS. L. F. Fieser and M. Fieser. Pp. vi + 116. *New York: Reinhold Publishing Corporation; London: Chapman & Hall Ltd, 1960.* 24s.

This helpful little book, an expanded version of an earlier pamphlet, has been written for chemists as a guide to the principles and practice of producing well-written chemical papers and articles. The authors take Fowler's *Modern English Usage* as their prime authority, and they have illustrated their work with numerous examples of good and bad usage from the chemical field. The result is a very useful book which, for the most part, is equally suitable for English and American authors.

The first 10 chapters deal with various grammatical points, the choice of words, punctuation and style. These chapters form a most useful collection of rules for good writing, and every author and potential author could study them with profit. Allowance must be made for expressions which are considered correct usage on

one side of the Atlantic but not on the other. For example, many British authors would shudder at some of the expressions to be found in the text of the chapter on 'style,' such as 'one cocks an eye at a paper . . .' (p. 54), and ' . . . not only at the beginning but for keeps' (p. 55). Chapter 11 consists of five pages on proof reading and word division. The first of these two sections accords with American rather than with British practice.

The remaining two chapters are much less satisfactory, and are largely irrelevant to the main purpose of the book. Of the 20 pages of Chapter 12, 'Pronunciation,' 16 consist of lists of words and their (American) pronunciation, while the five pages of Chapter 13, 'Speaking,' are extremely superficial. Unfortunately, too, the Index has been spoiled by the inclusion of all the words (about 750) from the pronunciation and word-division lists. These last pages detract from what is otherwise an excellent book.

Its price, 24s. for 97 text pages, is high by British standards. The omission of the chapters indicated, a shorter Index, and a less stout cover would have brought the book nearer the pocket of the readers for whom it was intended.

J. H. PRYOR

TRANSLATION FROM RUSSIAN FOR SCIENTISTS.

C. R. Buxton and H. Sheldon Jackson. Pp. xix + 299. *London: Blackie & Son Ltd; 1960.* 30s.

The problems that confront a scientist who wishes to learn Russian, and a teacher who wishes to impart this language to mature and otherwise busy minds, have recently received considerable attention in the English-speaking world. This book is a very welcome and valuable contribution to their solution.

The authors begin with a concise grammatical survey, which provides a clear and adequate starting point for the scientist who wishes to be able to translate. The student who reads this book will soon understand the grammatical structure of the language, and he will gain some insight into word-formation from the tables of prefixes, suffixes and roots. The grammar is followed with translation exercises, which are graded and arranged to illustrate particular aspects of grammar and construction. The student will thus be able to obtain practice at each section of grammar by work at the appropriate exercises, using a scientific vocabulary. This is quite an ordinary procedure in language study, but it appears here for the first time in a book devoted to scientific Russian, and will certainly form an extremely valuable part of any course.

After the exercises come annotated texts from Russian scientific literature, in which difficult words and constructions are explained.

By the time he reaches the end of these exercises and texts, the student will have acquired a sound basic vocabulary. He will then be in a good position to begin reading the final section, about a third of the book,

consisting of a collection of Russian texts, covering a wide range of chemical and physical subjects. These provide good practice in most of the vocabulary and language forms likely to be encountered in Russian scientific works in chemistry, physics and related fields.

At the end of the book there is an excellent vocabulary, which would be more useful to the student if the aspects of the verbs were indicated. This is a very minor deficiency in a book which will undoubtedly become a landmark in the teaching of Russian to scientists.

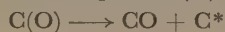
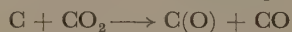
P. L. WYVILL

TECHNOLOGY, ENGINEERING AND SAFETY.  
VOLUME II. PROGRESS IN NUCLEAR  
ENERGY. SERIES IV. Edited by R. Hurst,  
R. N. Lyon and C. M. Nicholls. Pp. xvi + 799 +  
XII. Oxford: Pergamon Press Ltd, 1960. 105s.

The second International Conference on the Peaceful Uses of Atomic Energy held in Geneva in 1958 was the forum for a very large number of papers on all aspects of nuclear energy other than weapon technology. The task of collating and reviewing the work presented is a formidable one. Pergamon Press have undertaken the selection and editing of the more important review papers in a series of 12 volumes. The volume under review deals with the technology of reactors, that is to say, the chemistry, metallurgy and general engineering aspects of reactor design. It includes a section dealing with the problems of reactor safety, with particular reference to the containment of fission products released from the reactor core in 'incidents' and the shielding of the radiation from the core during normal operation.

The book has five chapters—reactor chemistry, reactor materials, engineering experience and practice, engineering studies and engineering aspects of reactor safety.

The chemist who is unfamiliar with nuclear energy technology will discover that his discipline finds a considerable application in the field of reactor technology. The graphite-moderated, natural uranium reactor, upon which the British nuclear power programme is founded, uses carbon dioxide as the coolant in the primary circuit. Although the maximum temperatures reached by the coolant and the graphite are only  $\sim 400^\circ\text{C}$ , the reaction between the carbon dioxide and the graphite is accelerated by the intense radiation, with the result that the graphite of the moderator is attacked and may be progressively removed by the coolant. The experimental work on this problem is described, and current theories of the principal reactions are discussed. The papers by Anderson *et al.* suggest two possible routes for the reactions in the absence of radiation. The first, referred to as the 'gasification reaction,' is believed to occur in two steps:



where C(O) is an active surface oxide and C\* is an active surface atom.

An alternative hypothesis suggests the following sequence:



The former hypothesis would demand that the volume of the system (at S.T.P.) would increase and that the reaction be limited by the equilibrium

$$K = \frac{[\text{CO}]^2}{[\text{CO}_2]}$$

The second hypothesis would call for no change in volume and an equilibrium controlled by the equation:

$$K = \frac{[\text{C(O)}][\text{CO}]}{[\text{C}][\text{CO}_2]}$$

In the latter instance, the equilibrium should depend on the ratio of graphite to gas in the system.

The work reported supports the 'active site' reaction *in the absence of radiation*, and the paper by Davidson *et al.* will be of interest to all chemists concerned with heterogeneous reactions.

Methods of reducing the reactivity of graphite are discussed by Tyzack. He concludes that protection by reducing the available surface by pitch impregnation and re-graphitizing is only effective 'out-of-pile,' that 'in-pile' the radiation-activated carbon dioxide is primarily responsible for the major part of the reaction and that the concept of 'active sites' has little validity for 'in-pile' reactions. Anderson and Lind describe the extensive work which has suggested this later hypothesis, and propose its extension to explain the deposition of carbon in the cooler parts of the circuit.

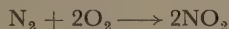
Whilst the experimentally determined results, both in the test loops and in the Calder Hall reactors, suggest that this attack of carbon dioxide on graphite proceeds at an acceptable rate and can be moderated by a small addition of monoxide, the work is of importance to the reactor designer who is seeking higher radiation fluxes and core temperatures. The papers are well illustrated and clearly presented.

The properties of hydrous oxides are discussed in Sections 1 and 2 with a view to their possible application to reactor coolant circuits, and Kraus *et al.* describe the absorptive properties of hydrous oxides in terms of ion-exchange chemistry. This section of the book is of general value, and should provide rewarding reading for the analyst and industrial chemist.

The sections dealing with the chemistry of boiling-water reactors and the radiation chemistry of organic moderated reactors are of interest to the specialist. Those dealing with the chemistry of molten fluoride melts, which have been considered for homogeneous reactor systems for aircraft propulsion, ably review the important problems and add substantially to fluoride chemistry. Again this section could be of interest to chemists whose field is outside that of nuclear energy.



Chapter 1 concludes with a stimulating paper by Cockelbergs *et al.* on the use of microporous uranium fuels to provide a high utilization of the fission-product energy in direct chemical conversions. The authors have studied the reaction



and have shown that the intimate contact provided by a microporous fuel can yield conversion efficiencies of up to 50 per cent (conversion efficiency being defined as energy utilized in a transformation at a known *G* value to fission energy available). The authors conclude that a 100 MW reactor could produce 25 MW of electrical energy and 2 tons of  $\text{NO}_2$ /hr. The paper does not consider the economics of the system, but the value of the nitric acid produced in such a plant would be a negligible fraction of the operating costs. Much remains to be done if the direct use of fission energy is to be applied to the chemical industry.

The remainder of the book is of less interest to the chemist who is not engaged in reactor technology, although Chapter 2, which deals with the effects of radiation on reactor materials and the corrosion resistance of Zr and Al alloys in steam-water mixtures, may be of some interest to the chemical engineer. For those engaged in these specialist fields the book may be of value in providing a readily available survey of reactor technology, although the specialist will already have acquired his own copies of the Geneva papers of direct interest.

Reactor technology covers a wide range of disciplines, and no one technologist can be conversant with the techniques to be found in each type of reactor. It is this wide scope that has set the editors a difficult task and may be the reason for the lack of a digested review of the value of each group of papers.

Rather than collating the papers into volumes devoted to reactor physics, or reactor technology, physics and mathematics and so on, it is probable that a better arrangement would have been to group the papers around reactor systems, such as graphite-moderated gas-cooled, graphite-moderated steam- or water-cooled, aqueous homogeneous reactors, and high-temperature homogeneous fluoride reactors. In this way the volumes would be more coherent, and would give the editors more opportunity for a critical survey of papers presented.

B. F. WARNER

A REFERENCE BOOK OF CHEMISTRY. J. H. White. Pp. 302. London: University Press Ltd, 1960. 21s.

This book consists essentially of a detailed list of important chemical terms, reactions, tests, ores and alloys and so on, with definitions. It is intended mainly for chemistry teachers and their senior pupils. At 21s. it is excellent value, and presents much material which is not readily available in standard textbooks. It

should also prove useful as a preliminary reference book in many laboratories. In general, the subject matter is up to date; for example, under 'Atomic Weight,' reference is made to the IUPAC recommendation for the  $^{12}\text{C}=12$  standard. There is also a useful appendix on first aid.

There are, nevertheless, a few important omissions and some obsolete data. For example, the Baeyer Strain Theory is explained, but conformational analysis is not listed. Grignard Reagents are defined as 'all organo-metallic,' yet inorganic Grignard Reagents were discovered in 1957. The oxonium ion is defined as a 'name that has been used for the hydronium ion.' This is a rather drastic restriction. In the next paragraph oxonium compounds are described as 'addition compounds' and the obsolete formula  $(\text{CH}_3)_2\text{O}\cdot\text{HCl}$  is given. Modern practice is to emphasize their ionic, salt-like character with the formula  $(\text{R}_2\text{OH})^+\text{Cl}^-$ . Hydrogen bonding is said to occur between electro-negative atoms, yet the boron hydrides are included under this definition. There is no reference to electron deficiency nor to many-centred bonds.

The laws of conservation of matter and energy are stated in the traditional manner and there is no mention of their interconversion at this point. However, the mass/energy relationship  $E = mc^2$  is stated for nuclear reactions. There is no reference to its small, though important, part in chemical reactions. The spintharoscope is described, and also its use in determining Avogadro's Number, but the scintillation counter is not listed.

These are mainly points of small importance for schools, but they may deny the book the wider circulation it otherwise deserves. Such faults are inevitable in first editions of reference books of this type and later editions will, no doubt, include the necessary corrections.

E. J. ROTHERY

FUNDAMENTALS OF CHEMICAL ENGINEERING OPERATIONS. M. G. Larian. Pp. xi + 644. London: Constable & Co. Ltd, 1960. 62s. 6d.

The number of textbooks available to the student of chemical engineering has in recent years increased considerably, and as a result new arrivals will be scrutinized more critically. The author aims at 'an analytical style, without however minimizing the role played by the empirical approach in engineering thinking . . .'; and if in this book he shows himself to be on the side of the angels, he includes fairly extensive discussion of typical equipment, sometimes in fair detail, and implying a broad definition of 'fundamentals.'

The book is divided into three sections: general principles, separation of mixtures by interphase mass transfer and mechanical separation of heterogeneous mixtures. That this division leads to difficulties

is shown in the first section, which deals in conventional manner with the general treatment of fluid flow, heat transfer and mass transfer, singly and in combination. Included in this section is a chapter—an excellent one as it happens—on evaporation and evaporators, presumably because it is difficult to fit in elsewhere in the scheme.

The chapter on fluid flow is probably the least satisfactory in the book, and in a book on 'fundamentals' could well be extended. The first sentence of the chapter is 'For a fluid to flow it should have or receive enough energy to overcome the resistance to flow,' but the precise nature of this resistance could well be enlarged upon. The chapter on heat transfer is generally good, though Fig. 1, showing in diagrammatic form the flow of heat through fluid films, is liable to be confused with fluid flow in a pipe. In general, this section suffers from the attempt to achieve brevity—too often at the expense of clarity and precision.

Section II deals with such operations as drying, distillation, extraction and absorption, and in this the author is much happier; Section III describes various gravitational and centrifugal separations and filtration. Some of the introductory material in the last section could with advantage have been dealt with in the first—with advantage both to the development of the ideas of fluid flow and to the idea of 'general principles.'

Certain operations are not dealt with at all—crushing and screening for example. On the other hand, the book has a number of interesting additional items such as the treatment of vapour recompression. On the whole, however, the book suffers mainly in its title—it is not really a textbook on fundamentals, unless the interpretation of 'fundamental' is very generous.

D. M. WILSON

#### SMALL SCALE EXPERIMENTAL CHEMISTRY.

T. A. H. Peacocke. Pp. xii + 164. *London: Longmans, Green and Co. Ltd.*, 1960. 8s. 6d.

The title of this book seems inappropriate, as the author deals mainly with inorganic qualitative analysis, with one chapter (pp. 21) devoted to inorganic preparations. The field of preparative organic chemistry, where small-scale methods have been longer established, is not included.

The book is divided into three parts. Part I deals with the theoretical principles underlying, and the reactions of cations and anions covered by, the Advanced and Scholarship level syllabuses; the seven chapters include one describing the apparatus and technique of semi-micro qualitative analysis. In Part II (three chapters) the theory and practice of qualitative analysis are developed along traditional lines, and extended to include interfering radicals beyond the level normally attained in grammar-school teaching. Part III is devoted to the preparation of 20 inorganic compounds divided into five groups, the scale of working being

designated as small-scale, semi-micro or micro, according to the yield obtained. There are two appendixes, one dealing with reagents and the other with the construction of apparatus.

In a book of this size it is always difficult to know how much basic theory to include and where to start. The author begins with atomic structure and chemical bonds but can do justice to neither in the few lines devoted to them. It would perhaps have been better to omit these two sections and begin with 'Behaviour of Solutions' (p. 7), assuming a knowledge of the electronic theory. This is a matter of opinion and is in no way a criticism of his sound approach to reactions in inorganic chemistry.

The practical instructions given in the book are also sound, particularly as to the quantity of material to be used in this scale of work (10 mg, p. 107); so often recommended quantities are far too large. On p. 26 the volume of a semi-micro test-tube is given as 2 ml; it is in fact 4 ml.

It appears that the tables of separation have been devised for the analysis of substances containing only one element per group, that is for G.C.E. work, but the author's intention to use them beyond this level—presumably for mixtures containing more than one element in a group—is open to criticism, particularly for group II. The use of caustic soda and hydrogen peroxide to separate the copper sub-group from the arsenic sub-group (p. 109) must cause some sulphate formation and consequently contaminate the soluble portion. The treatment of the IIA precipitate with concentrated hydrochloric acid instead of the more usual dilute nitric acid (p. 124) does not separate copper from cadmium. In general this table cannot be recommended for more advanced work.

The section on inorganic preparations, while interesting and useful, seems out of place in a work devoted principally to qualitative analysis. One worth-while feature in this section, however, is the suggested utilization in certain cases of some of the yield to establish quantitatively its purity.

The appendix describing the make-up of the reagents used would be improved if their strengths were expressed in molarity where appropriate.

For its price, the book is well produced and relatively free from printer's errors; the text is richly illustrated with equations, but because of the systematic scheme of separation referred to above, it can receive only limited recommendation.

H. HOLNESS

#### INTRODUCTORY MODERN CHEMISTRY. PART I.

R. W. de M.-Maclay. Pp. 143. *Sydney: National Enterprises*, 1960. 15s. (Aus.).

During the last few years many G.C.E. 'O' level textbooks in chemistry have appeared in which the authors have attempted to explain chemical phenomena in terms of modern scientific knowledge. These attempts are all



most laudable, since it is manifestly inefficient to teach classical theories at the introductory stage only to have to amend them later in the light of modern knowledge.

Mr de M.-Maclay has endeavoured to present explanations, in terms of electron theory, of the physico-chemical basis of the G.C.E. 'O' level syllabus. Ionic and covalent linkages are explained clearly and lead to an interpretation of the electrochemical series, the reactions of the metals with water, acids, bases and salt-formation. This has been done in an appealing style and the text is very readable. However, by now half the book has been written, and there still remains a vast amount of the syllabus as yet untouched. A few brief chapters are devoted to the most important chemical compounds, and then the author, mindful of his title, launches out into a historical review of the electron, its orbital arrangements in atoms, the wave nature of matter, nuclear disintegration and thermo-nuclear reaction, all done in a dozen pages, presumably to stimulate interest in Part II (as yet unpublished).

As a textbook for 'O' level G.C.E. chemistry courses, as at present constituted in this country, this book could hardly be recommended, for to cover the ground that the author has done in 130 pages is to produce something which must inevitably give superficial treatment to large areas of the syllabus. However, this is an interesting attempt, and it could be used with great benefit as an auxiliary 'O' level book in this country. I look forward to the publication of Part II.

W. O. M. WILLIAMS

ENCYCLOPAEDIA OF MICROSCOPIC STAINS. E. Gurr. Pp. xii + 498. London: Leonard Hill (Books) Ltd, 1960. 95s.

*Encyclopaedia of Microscopic Stains* is the first serious attempt yet to put into a single volume most of the common (and some quite uncommon) dyestuffs used as stains in microscopy. The main part of the book consists of an alphabetical list of these stains, showing their molecular weights, structures and solubilities in water, absolute alcohol, cellosolve, ethylene glycol and xylol. The groups to which the dyestuffs belong are also given, as well as the properties and the more general uses to which the stains are applied.

Since so much of microscopy consists in rule-of-thumb working and in remembering the rules, it is quite certain that a book of this kind serves a useful purpose if only to teach the user something of the organic chemistry of the dyestuffs which he applies to tissues, sections and films. The next step, of course, would be to state why a particular stain is used. Doubtless this will be the subject of a future book when more is known on the subject.

Some of the lesser known dyestuffs are dismissed in a few lines, but the more important stains are given full treatment. Thus, Fuchsin is given over three pages of written matter. It is pointed out that in the main

three dyestuffs are involved, all being of the triphenyl-methane series. Traces of higher homologues are also present. The manifold uses for Fuchsin and its various combinations are described, and when presented in this fashion could be of great informative value to those studying staining technique. Other main staining dyes are treated in a similar fashion. Consequently, the book will be of considerable value to the practising microscopist.

The second section is a list of dyes and indicators merely mentioned by name. The third is on Diazonium salts and bases and the last part concerns Tetrazolium and Formazans.

The book is well produced and the printers have made a good job of setting out the structural formulae and of the general presentation. Mr Gurr is very experienced in the use and preparation of dyestuffs, indicators and so on, and it is quite certain that here he is trying to pass on some of the ideas which he has collected in this field over a good many years.

R. F. MILTON

## PUBLICATIONS RECEIVED

STATES OF JERSEY REPORT OF THE OFFICIAL ANALYST FOR 1959. Pp. 19. Jersey: Bigwoods Ltd, States' Printers, 1960. 1s.

STABILIZATION OF FREE RADICALS AT LOW TEMPERATURES. Summary of the N.B.S. Programme. Edited by A. M. Bass and H. P. Broida. National Bureau of Standards Monograph 12. Pp. 110. Washington: U.S. Government Printing Office, 1960. \$1.50.

SPECIFIC HEATS AND ENTHALPIES OF TECHNICAL SOLIDS AT LOW TEMPERATURES. A Compilation from the Literature. R. J. Corruccini and J. J. Gniewek. National Bureau of Standards Monograph 21. Pp. 20. Washington: U.S. Government Printing Office, 1960. 20c.

STANDARDIZATION ACTIVITIES IN THE UNITED STATES. A Descriptive Directory. S. F. Booth. National Bureau of Standards Miscellaneous Publication 230 (supersedes miscellaneous publication M169). Pp. 210. Washington: U.S. Government Printing Office, 1960. \$1.75.

DERWENT PATENTS ABSTRACTS CATALOGUE. Pp. 38. London: Derwent Information Service, 1960. 2s. 6d.

WATER CONSERVATION. Bibliography of References in the Published Literature, including some of the chief references to the literature in Allied Fields. Technical Publication No. 7. Price's (Bromborough) Ltd, 1960.

BRITISH STANDARDS

903: Part A17: 1960. Methods of Testing Vulcanized Rubber. Determination of the Permeability of Rubber to Gases. Pp. 11. 4s. net.

# Institute Affairs

## PRESIDENT DESIGNATE

Sir William Kershaw SLATER, K.B.E., F.R.S., has been nominated by the Council for election as President of the Institute for the period of two years from the date of the Annual General Meeting, 1961. Sir William has indicated that he will be prepared to accept this office if duly elected in the forthcoming Ballot for the election of Honorary Officers and General Members of the Council.

## ANNUAL CONFERENCE, SOUTHAMPTON

20-22 April, 1961

The response to the announcement about the Annual Conference to be held in Southampton next April has been much greater than was expected. The number of members and their guests who have indicated that they may wish to take part now exceeds 750, and although the arrangements have been drastically revised it may not be possible to accept registrations from all those who have given provisional notice of attendance.

However, copies of the revised Programme of Events and Registration Forms will be sent to those members who completed and returned the questionnaire forms that were circulated in December, 1960. It is regretted that application from other members cannot be accepted.

## NOMINATIONS FOR DISTRICT MEMBERS OF THE COUNCIL

The following nominations were received by the closing date, 30 November.

All these candidates are deemed to have been elected with effect from the date of the Annual General Meeting, 1961. Names given in *italics* are those of newly elected members, the others having been re-elected.

### England

- I Walter Wilson, B.SC., PH.D., D.SC., A.R.C.S., D.I.C.
- II Frederick Denison Maurice Hocking, M.SC., M.B., B.S., L.R.C.P., M.R.C.S., A.C.G.F.C., M.L.BIOL.
- III *Louis Hunter*, PH.D., D.SC.
- IV Reginald Langham Elliott, B.SC., PH.D., F.T.I., F.S.D.C.
- V Percy Noel Williams, M.SC.
- VI Frederick Cecil Hymas, M.SC.  
Samuel Aaron Miller, M.A., B.SC., PH.D.
- VII Sidney John Fletcher, B.SC., PH.D., D.L.C.
- VIII *Leslie Horton Williams Hallett*, M.A., B.SC.
- IX Leonard Balmforth, B.SC.
- X *Frank Henry Day*, M.SC., PH.D.
- XI Richard Eric Parker, B.SC., PH.D.

### Wales and the County of Monmouth

- I *Percival Francis Ellis*, M.B.E., B.SC.
- II William Rogie Angus, M.A., PH.D., D.SC.

### Scotland

- I Mearns Bruce Watson, B.SC., PH.D.
- II Frank Bell, PH.D., D.SC., F.R.S.E.
- III Patrick Dunbar Ritchie, B.SC., PH.D., F.P.I., M.I.CHEM.E., F.R.S.E.

### Northern Ireland

William Ford Kirkpatrick, A.H.-W.C., F.I.C.I.

### Republic of Ireland

Denis Crowley, M.SC., F.I.C.I.

## SUMMER SCHOOL IN ANALYTICAL CHEMISTRY, 1962

As already announced (*J.*, 217), the next Summer School in Analytical Chemistry will be held at the Manchester College of Science and Technology on 9-15 September, 1962.

The School will consist of the following four separate but concurrent courses, with Course Leaders as indicated:

- Course I: *Organic Analysis*: Dr D. W. Mathieson, Reader in Pharmaceutical Chemistry, School of Pharmacy, University of London.
- Course II: *Recent Developments in Inorganic Analysis*: Mr W. T. Elwell, Chief Analyst, Imperial Chemical Industries Ltd, Metals Division, Witton.
- Course III: *Detection and Determination of Trace Toxic Substances*: Mr H. E. Stagg, Chief Analyst, Imperial Chemical Industries Ltd, Dyestuffs Division, Blackley.
- Course IV: *Newer Instrumental Techniques*: Dr V. S. Griffiths, Reader in Spectroscopy, Battersea College of Technology.

It is expected that Course I will be concerned mainly with modern instrumental methods of elucidating the structure of organic compounds, including such methods as infra-red spectroscopy, nuclear magnetic resonance, mass spectrometry and spectropolarimetry. Course II will include recent developments in the analysis of less familiar elements, such as zirconium, tantalum, niobium, hafnium, beryllium, titanium and vanadium, as well as techniques of analysis for trace elements. Course III will deal with the detection and determination of trace toxic inorganic and organic substances in the atmosphere, topics that are of particular importance in industrial cities. Recent developments in ultra-violet spectroscopy and newer instrumental techniques such as atomic absorption, X-ray fluorescence and flame photometry will form part of Course IV, which will be generally concerned with instrumentation and automation in the chemical laboratory and industrial plant.

The Summer School is being organized by an Executive Committee under the Chairmanship of Dr C. W. Herd, *Vice-President* of the Institute, with Mr H.



Holness as Honorary Secretary. The Committee consists of representatives of the Council, the Manchester and District and the London Sections of the Institute, and of the Society for Analytical Chemistry, together with the four Course Leaders. The Secretary of the Committee is Mr D. G. Chisman, *Education Officer*.

## THE TEACHING OF INORGANIC CHEMISTRY

A one-day symposium on the teaching of inorganic chemistry at pre-university level will be held in the Donnan Laboratories, University of Liverpool, on 15 April. The symposium, which has been arranged to follow the Annual Meeting of the Chemical Society in Liverpool (11–14 April), is being organized by the Liverpool and North-Western Section of the Institute.

Among the speakers will be Professor C. C. Addison (University of Nottingham), Dr H. M. Irving (University of Oxford), Professor R. S. Nyholm, F.R.S. (University College, London), Dr A. G. Sharpe (University of Cambridge) and Dr J. E. Spice (Winchester College). Discussion sessions will be introduced by experienced teachers of chemistry.

Application forms are being distributed with this issue of the *Journal* to all members in the following Sections: Birmingham and Midlands, Huddersfield, Leeds Area, Liverpool and North-Western, Manchester and District, North Lancashire, North Wales, and Sheffield, South Yorkshire and North Midlands. Additional forms may be obtained from 30 Russell Square, London, W.C.1, or from Mr H. R. Jones, Hon. Secretary, Liverpool and North-Western Section, The Central College of Further Education, Carlett Park, Eastham, Wirral. The registration fee for the symposium is 10s., which includes morning coffee and afternoon tea.

**Education for Management.**—The Council has accepted an invitation from the Minister of Education to appoint a representative to serve on the newly established Advisory Council for Education in Management. In view of the importance of the work that the Advisory Council will be asked to undertake, it has been decided to nominate Mr E. LeQ. Herbert, *President*, as the Institute's representative.

Mr Herbert is Managing Director of the Shell Refining Company, and has wide experience, as well as a special interest, in education and training for high-level management.

**Liaison Officers in Technical Colleges.**—Changes in Liaison Officers that became effective on 1 January are:

*Hatfield Technical College.* Dr R. F. Robbins, *Associate*, in succession to Dr F. Lester;

*Portsmouth College of Technology.* Dr J. W. Griffin, *Fellow*, in succession to Mr C. M. Bere.

**Joint Library Committee.**—The Council has re-appointed the following members as representatives of the Institute on the Joint Library Committee for the year beginning 1 January, 1961:—Mr A. L. Bacharach, Mr H. W. Cremer, C.B.E., Dr J. H. Skellon and Mr E. J. Vaughan.

## PERSONAL NOTES

### New Year Honours

The Officers and Council extend their cordial congratulations to the following Members, whose names appeared in the New Year Honours List:

- Baron* Sir Alexander FLECK, K.B.E., HON.LITT.D., D.S.C., HON.LLD., F.R.S. Chairman, Advisory Council on Research and Development, Ministry of Power, and of the Nuclear Safety Advisory Committee.
- C.B.E.* Joseph Brightwell ALEXANDER, M.S.C., PH.D., A.R.S.M. Director, Geological Survey, Federation of Malaya.
- Frank Tinley INGHAM, B.S.C., PH.D., A.R.C.S., D.I.C., M.I.M.M. Lately Director of Geological Survey, Cyprus.
- Ernest James VAUGHAN, M.S.C., A.R.C.S., D.I.C., F.I.M. Director of Materials Research, Royal Naval Scientific Service.
- Gordon Edward WATTS, M.A., PH.D., B.S.C. Principal, Brighton Technical College.
- O.B.E.* Leslie James BURRAGE, PH.D., D.S.C. Deputy Chairman, North West Regional Advisory Council for Further Education.
- Norman Roy HOOD, B.S.C., PH.D. Director, British Paper and Board Industry Research Association.
- Arthur JACKSON, B.S.C., PH.D. Lately Director of Chemistry, Malaya.
- Ernest George Vincent NEWMAN, B.S.C., A.R.S.M., F.I.M., M.I.M.M. Principal Scientific Officer, Royal Mint.
- M.B.E.* Kenneth MACINTYRE, A.R.C.S. Experimental Officer, Chemical Inspectorate, War Office, formerly Ministry of Aviation.
- Denis Scott WILSON. Senior scientific intelligence officer, Civil Defence Corps, Croydon.

### Honours and Awards

Professor F. S. Dainton, F.R.S., *Fellow*, has been elected to an Honorary Fellowship at St Catharine's College, Cambridge.

Mr B. S. Dyer, *Fellow*, has been awarded the Silver Medal of the Plastics Institute for the year 1959–60; it was presented to him by the President of that Institute on 3 November.

Sir Cyril Hinshelwood, O.M., F.R.S., *Fellow*, has been awarded the new Royal Society medal (to mark the Tercentenary) for his contributions to physical chemistry. The gift of the trustees of the Leverhulme Trust Fund, it is to be awarded every three years for 'the most significant contribution in the field of pure and applied chemistry or engineering, including chemical engineering.'

Mr J. R. Jarratt, *Associate*, chemical factory manager, Boots Pure Drug Co. Ltd, Nottingham, has been awarded the Lampitt Gold Medal of the Society of Chemical Industry.

**University of London.**—Dr T. V. Arden, *Fellow*, and Dr T. G. Bonner, *Fellow*, have been awarded the degree of Doctor of Science.

### Societies and Institutions

Mr L. W. Blundell, *Fellow*, controller of by-products, North Thames Gas Board, was elected Hon. Treasurer of the British Tar Confederation at a recent meeting.

Dr R. M. Thakkar, *Associate*, has been appointed the first Hon. Secretary of the new Indian Section of the Plastics Institute. This is the second oversea section of the Plastics Institute, the first being in South Africa.

**Royal Society.**—The following *Fellows* have been elected as officers of the Royal Society: Treasurer, Sir Alexander Fleck, K.B.E.; Foreign Secretary, Sir Patrick Linstead, C.B.E.; Members of Council, Mr R. P. Bell, Sir Christopher Ingold and Professor R. A. Morton.

### Consultant

Dr T. White, *Fellow*, Hon. Editor of the Journal of the Society of Leather Trades' Chemists and lately director of research, Forestal Land, Timber & Railways Co. Ltd, has set up an independent consulting practice at 'Highlands,' Wood End Road, Harpenden (Tele: Harpenden 352). He will advise on industrial research and development; technical writing and publication; leather and tannin chemistry; and on certain aspects of plastics and adhesives, corrosion, particle dispersal, flocculation and flotation, and microbiology.

### Educational

Dr E. I. Chappell, *Associate*, formerly of Bolton Technical College, has been appointed head of the department of chemistry and metallurgy, Chesterfield College of Technology.

Dr R. J. Gillespie, *Fellow*, has been appointed Professor of Chemistry, McMaster University, Hamilton, Ontario.

Professor S. H. Harper, *Fellow*, has been re-elected Dean of the Faculty of Science, University College of Rhodesia and Nyasaland, for 1961.

Dr M. Prasad, *Fellow*, has completed his term of office as Vice-Chancellor of the University of Vikram, Ujjain, and has now moved to Pipalmandi, Agra, intending to work at the University of Agra.

Dr C. B. Taylor, *Fellow*, has taken up the post of senior chemistry master, Totnes Grammar School.

Dr J. D. Thornton, *Fellow*, has been appointed reader in chemical engineering, King's College, Newcastle.

### Public and Industrial

Dr I. Berkovitch, *Fellow*, has resigned from the position of associate editor, *British Chemical Engineering*, and been appointed chief chemist, Polycell Products Ltd.

Mr M. Bishop, *Associate*, has resigned as chief analyst, Coal Survey Laboratory, National Coal Board, to take up the position of chief chemist, Churchill Gear Machines Ltd, Blaydon on Tyne.

Mr D. E. Blenford, *Fellow*, works manager, B. Young & Co. Ltd, has recently been appointed a director of the company.

Mr B. F. Bowles, *Associate*, is now working as a development engineer for the Transatron Electronic Corporation, Wakefield, Mass., U.S.A.

Dr J. Chanmugam, *Fellow*, has been appointed to the regular staff of the International Finance Corporation, Washington, and took up his duties as engineer on 1 December.

Mr N. F. Daniel, *Fellow*, who has been assistant general manager of Semtex Ltd, a Dunlop subsidiary, has been appointed general purchasing manager for the Dunlop Group.

Dr E. J. Dickinson, *Fellow*, is leaving South Africa to take up an appointment as head of the coal tar section of the coal research division, C.S.I.R.O., Chatswood, New South Wales.

Dr R. Gaze, *Fellow*, chief scientist of the Cape Asbestos Co. Ltd, has been appointed a director of Cape Insulation & Asbestos Products Ltd, Cape Asbestos Fibres Ltd and Capasco Ltd, all wholly-owned subsidiaries of the Cape Asbestos Co. Ltd.

Dr A. B. Hart, *Associate*, has left the Royal College of Science and Technology, Glasgow, and is now head of a laboratory in the advanced projects division of the Central Electricity Generating Board's research and development department.

Mr N. M. Harvey, *Associate*, has been appointed to the records and research department of Imperial Chemical Industries Ltd, in their southern sales region.

Mr D. Hastilow, *Associate*, has accepted a position with Reichhold Chemicals Inc., Botany, New South Wales, Australia.

Dr D. H. Hayes, *Associate*, formerly with the department of biological chemistry, University of Michigan, has joined the staff of the Institut Pasteur, Paris.

Mr A. Herzka, *Associate*, recently attended the 47th Annual Meeting of the Chemical Specialties Manufacturers Association, held in Florida. He also attended the Annual Meeting of the Society of Cosmetic Chemists and the meeting of the scientific section of the Toilet Goods Association in New York.



Dr W. R. Jondorf, *Associate*, has left the U.S.A. to take up an appointment with the Pesticide Research Institute, London, Ontario.

Mr J. M. Kershaw, *Fellow*, has taken over the duties of production director, Monsanto Chemicals Ltd.

Mr H. A. Nava, *Associate*, has returned to the U.K. from Bombay, and is now with Batchelors Foods Ltd, Sheffield.

Dr H. E. North, *Associate*, production manager, heavy organic chemicals division, Imperial Chemical Industries Ltd, has joined the Board as production director.

Dr S. M. Partridge, *Fellow*, has been appointed head of the eggs and poultry department, Low Temperature Research Station, Cambridge. He will continue in charge of the protein and ion-exchange department.

Mr A. Ridley, *Associate*, has left the A.E.R.E., Harwell, to become an alkali inspector, Ministry of Housing and Local Government.

Mr R. C. Rooney, *Associate*, has given up his post with the British Cast Iron Research Association, and has joined the analytical and testing department of B.I.P. (Chemicals) Ltd.

Mr J. Robinson, *Associate*, has left the British Cotton Industry Research Association to take up an appointment as development chemist, Hickson & Welch Ltd, Castleford.

Dr Q. M. Siddique, *Associate*, is now a process chemist with the Attock Oil Co. Ltd, Morgah, Rawalpindi, West Pakistan. He was formerly at the department of chemical engineering, University of Birmingham.

Mr T. H. Wilde, *Associate*, has been appointed assistant managing director of Union Carbide Europa S.A., and will be responsible for co-ordinating all sales operations. He was formerly manager of the company's metals department.

Mr R. M. W. W. Wilson, *Fellow*, has joined J. W. & T. A. Smith Ltd, London. He was formerly at the Wick Lane Colour Works of W. Symonds Ltd.

**British Hydrocarbon Chemicals Ltd.**—Mr C. E. Evans, C.B.E., *Fellow*, has been appointed managing director of the company. Mr M. A. L. Banks, *Fellow*, has been appointed a director.

**Imperial Chemical Industries Ltd.**—The number of Functional Directors has been reduced from eight to six, and the number of Group Directors from six to five. Among the Functional Directors are Dr J. S. Gourlay, *Fellow*, Overseas, Region (C); Mr C. M. Wright, *Fellow*, Personnel, and Dr J. Ferguson, *Fellow*, Research and Development. Among the Group Directors are Dr J. Ferguson (Group A, alkali and general chemical divisions); Mr G. K. Hampshire, *Fellow* (Group B, dyestuffs, paints and pharmaceuticals divisions); Mr C. Paine, *Fellow* (Group C, fibres, heavy organic chemical and plastics divisions); and Dr J. Taylor, M.B.E., *Fellow* (Group E, metals division).

## Section Activities

### BIRMINGHAM AND MIDLANDS

On 10 November Mr F. L. Cann addressed a joint meeting of the Section and the Society for Analytical Chemistry on 'Analytical Problems in Forensic Toxicology.'

Professor G. W. Kenner spoke on 'Some Recent Developments in the Porphyrin Field' at the University of North Staffordshire, Keele, on 6 December. The vote of thanks was moved by Dr I. T. Millar, a former colleague of Professor Kenner.

On 7 December Dr L. Valentine lectured on 'The Sorption of Water Vapour by Polymers' at Coventry. The vote of thanks was proposed by Mr F. C. Smith, Principal of Coventry Technical College.

Mr G. King took the Chair at all three meetings, which were very well attended and followed by lively discussions.

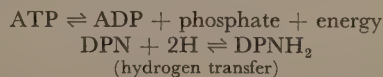
### CUMBERLAND AND DISTRICT

*Chemical Bases of Human Energy.* At a meeting held in the Windscale Club, Seascale, on 18 November, under the chairmanship of Mr J. S. Nairn, Professor Hugh Nicol, F.R.S.E., gave a lecture on 'The Chemical Bases of Human Energy.'

Professor Nicol introduced his talk by reading from a tribute to J. R. Mayer by Tyndall, written nearly 100 years ago, in which some modern concepts of body energetics and the continual renewal of body cells were strikingly forecast.

The body derives its energy essentially from oxidation of carbon and hydrogen in fats, carbohydrates and proteins to the energy-less carbon dioxide and water as end-products. Hydrogen attached to nitrogen—like nitrogen itself—yields no energy, yet the roles of nitrogen and phosphate are vital. The main concern of the lecturer was to illustrate the manner in which oxidations and other metabolic changes are accomplished in the body, and the way in which the energy so released is utilized for muscular action, as well as heat-production, within the body.

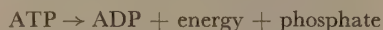
Two compounds of nitrogen have central importance in these functions: adenosine triphosphate and so-called diphosphopyridine nucleotide. Both are complex derivatives of the same pentose: D-β-ribose. They act reversibly:



In the oxidative changes, breakdown is accomplished by phosphorylation reactions involving ATP and dehydrogenation reactions linked with DPN. Energy is released as heat or is stored in the form of energy-rich phosphate bonds (involving the consumption of inorganic

phosphate); the step-wise processes can be assessed in terms of numbers of molecules of ATP formed.

In muscular action, the energy required is supplied directly from ATP in the following way:



It has been shown that muscles themselves contain a small store of ATP which can be called upon immediately. If this is insufficient, more ATP can be produced by the oxidation of glucose in the blood (or released by hydrolysis of glycogen, the form in which carbohydrate is stored in the body). In the presence of an ample oxygen supply, glucose is oxidized completely to carbon dioxide and water, but in circumstances where the muscles are called upon for violent exercise and oxygen cannot be supplied quickly enough, energy may still be provided by the anaerobic oxidation of glucose to lactic acid.

The lecture stimulated an interesting discussion, and Mr J. H. Tonkin proposed a vote of thanks to Professor Nicol for illuminating a fascinating aspect of chemistry which, to many in the audience, was quite new.

#### DUBLIN AND DISTRICT

At a meeting held on 5 October, in the Chemistry Department, University College, Dublin, Mr I. R. McAuley, of Queen's University, Belfast, gave a lecture on 'Radiocarbon Dating by the Use of Scintillation Techniques.' Mr H. D. Thornton was in the Chair.

The lecturer introduced his talk by describing the principles involved in the method of radiocarbon dating and the assumptions involved in the theory. The types of experimental arrangements used in the various dating systems were listed with their advantages and disadvantages, and the reasons for the adoption of the liquid scintillation method, as used in Trinity College, Dublin, were outlined.

He continued by describing this system in detail, and compared its effectiveness with the other methods in use. He dealt with the methods used to reduce the background counting rate due to cosmic rays and stray radiation, and the requirements of an ideal sample liquid for addition to the liquid scintillator. He then explained to what extent these requirements were met by methanol.

Mr McAuley concluded his address by outlining the procedures adopted during routine dating of specimens, some of the results obtained during the routine operation of the equipment and the statistical errors inherent in the system.

Following a discussion, the Chairman brought the meeting to a close by conveying the thanks of the Section to the lecturer.

#### DUNDEE AND DISTRICT

*Colour Photography.* On 21 October Mr D. Brownbill, of Ilford Ltd, Essex, delivered a lecture entitled 'Colour

Photography' in the Chemistry Lecture Theatre, Dundee Technical College. Mr J. Wylie was in the Chair.

All modern colour photographic processes depend on the inability of the human eye to analyse a particular colour in terms of its wavelength distribution. For example, a colour can be synthesized either by mixing light corresponding to three narrow bands in the blue, green and red portions of the spectrum or by taking a mixture of wavelengths forming a broad band of the spectrum, and the eye will be unable to distinguish between the two.

Although there remains some doubt as to the mechanism by which colours are seen, it is convenient to think of the eye as possessing three types of receptor in the retina, each sensitive to roughly one-third of the visible spectrum, and it is easy to show that any colour can be reproduced by a mixture of suitable quantities of the light to which these receptors are sensitive, that is to blue, green and red.

Colour photographic processes depend on producing three records of the original scene, each record carrying the information relating to the blue, green or red components of the scene. This may be done by exposing three negatives to the same subject behind blue, green and red filters. From these negatives black and white positives may be made and if these three positives are projected in register through the same blue, green and red filters, the original scene will be reproduced. This system is known as the additive system, since the three primary records are added together to simulate the original. In order to avoid making three separate negative exposures, the three records may be displaced spatially by the use of a screen or *réseau* and a single emulsion will then record the required information.

In the additive system the amount of light from each of the three records (or separation) is controlled by a black silver positive. This is inefficient, since the light from the red separation, for example, may be controlled by a positive coloured the complementary colour to red, namely blue-green. Similarly the green information may be controlled by a blue-red (magenta) positive and the blue information by a red-green (yellow) positive. Such coloured positives will absorb only the light from the particular separation they control, and unlike the black positives used in the additive process will not affect light from the other two separations. For this reason they do not need to be separated and may be placed on top of one another in precise register. This system is called the subtractive system, since each coloured positive subtracts from white light the colour to which it is complementary.

All current processes are of the subtractive type, but may differ in the details of how the coloured positives are produced. Almost all processes make use of the system of chromogenic development to produce dyes in conjunction with a silver image, the silver being



subsequently bleached to leave only a dye image. The dye positive image may be produced either by the reversal processing of the material exposed in the camera, forming the dyes in the second development and giving a colour transparency, or a two-stage process of colour negative and colour positive may be used, parallel with conventional black and white photography. In the latter process the dyes are formed at the same time as the negative is developed and represent a negative record of the subject both in tone and in colour, that is any colour in the subject will record as its complementary in the colour negative. This colour negative is then printed, usually on to a colour paper, when the whole process is repeated to reproduce the original.

This negative-positive process has the advantage that it enables a compensation to be made for certain imperfections in the properties of the dyes used. Ideally, each dye positive should control only the separation corresponding to its complementary colour, and have no effect upon the other two. In practice this is not achieved, the magenta dye, for example, absorbing not only green light but an appreciable quantity of blue. This imperfection in the dyes leads to faulty reproduction of certain colours, and in a two-stage process where prints are required this is a serious drawback. It may be overcome to a great extent by a procedure called masking. If in conjunction with the magenta dye positive, for example, a yellow negative of rather lower contrast were produced, the net effect would be a constant blue absorption, so that the unwanted blue absorption of the magenta dye is effectively uniform over the whole of the picture area. In the masked negative processes, this yellow negative image is produced by colouring yellow the dye-coupler used to form magenta dye.

After discussion, the vote of thanks was proposed by Mr Leonard, of Dundee Photographic Society.

*Analytical Chemistry.* On 11 November Dr J. Haslam, chief analyst, Imperial Chemical Industries Ltd, Plastics Division, Welwyn Garden City, gave a lecture entitled 'Some Observations on Analytical Chemistry' in the Chemistry Lecture Theatre, Dundee Technical College. Mr R. S. Nicolson was in the Chair.

Dr Haslam demonstrated the new apparatus for use in gas-liquid chromatography and in particular for the trapping of separate fractions. This apparatus permitted transfer of milligram amounts of liquid substances to suitable infra-red cells. The new developments in the use of the oxygen combustion flask were described, and the linking of these new methods with modern titrimetric and colorimetric procedures of determination was dealt with in some detail. Observations were made on some newer colorimetric methods of analysis and some recent changes in automatic potentiometric titrimetry.

After a lively question time the vote of thanks was proposed by Dr A. Nechvatal.

#### HUDDERSFIELD

On 1 December Mr D. H. Desty, of the British Petroleum Co. Ltd's Research Centre, lectured at the Alexandra Chambers, Huddersfield, on 'Recent Advances in Gas Chromatography.' The meeting was held jointly with the Chemical Society of the Huddersfield College of Technology, and the Chair was taken by Dr E. Tittensor.

A survey of recent developments in the experimental techniques of gas chromatography in the last two years was given. After a brief general introduction, the important new very sensitive detectors based on gaseous ionization were described, with emphasis on the well-established argon and flame ionization types. Column packings were then dealt with, the most important developments being the use of reversible complex formation to achieve very specific separations and modifications of solid adsorbents to provide more homogeneous adsorption surfaces.

Most of the lecture was, however, concerned with coated capillary columns which enable very high separation efficiencies to be attained. The difficulties of introducing the very small samples required by these columns were discussed, and a complete apparatus employing a hydrogen flame ionization detector capable of operating up to 250°C was described. Some of the potentialities of these columns for both high-efficiency and high-speed elution were illustrated by chromatograms of hydrocarbon mixtures. With a glass column 900 ft long and 0.005 in. internal diameter, a total plate number of over a million theoretical plates had been achieved, which enable almost all the hydrocarbons in a light petroleum distillate to be separated.

The lecture was followed by a very interesting and active discussion, and finally the vote of thanks was proposed by Mr W. S. Mitchell.

#### LEEDS AREA

*Annual General Meeting.* The A.G.M. of the Section was held at the University of Leeds on 14 November, Mr R. K. K. Fourness presiding. The Section was honoured by the presence of Mr Clifford Paine, *Vice-President*, who conveyed greetings from the President and welcomed individually those who had been elected to corporate membership during the year. The report and financial statement were adopted, and Dr P. A. Briscoe and Messrs R. A. Dalley, A. Thomson and G. J. Weston were elected to the Committee. Mr Fourness announced that Dr D. McNeil had been elected Chairman of the Section for the year. Mr J. G. Hopkinson moved a vote of thanks to the retiring members of the Committee and spoke appreciatively of the great services which Mr Fourness had rendered to the Section during his term of office.

*Economic Trends.* The meeting was then thrown open, and Mr Clifford Paine addressed a large audience on

'Economic Trends in the Chemical Industry.' The lecturer showed that the growth rate of the U.K. chemical industry in terms of annual investment and production during the last decade had been rather more than twice that of all other manufacturing industries in this country. Analysis of world statistics for chemical exports, broken down into broad chemical classes, showed striking growth rates, particularly in plastics, pharmaceuticals and petroleum chemicals. In thermoplastics the recent growth rate had been around 20 per cent compound per annum. It is estimated that the world capacity for polyethylene production is now about 1 million tons per annum, having risen six-fold in the short time since 1954. In speaking of the growth of the petroleum chemical industry, he referred to the report of the Wilson Committee on coal derivatives, and the probable swing away from coal as a source of chemical carbon in the next 10 years. Reference was made to trends in the synthetic fibre industry, and the impact of changes in consumer habits and distribution of purchasing power, particularly in teenage groups.

In the ensuing discussion the lecturer emphasized the export difficulties which the British chemical industry would face because of political-economic changes, in Europe particularly. Several speakers referred to the fact that other competitive countries were more favourably placed for oil raw materials than Britain, although the post-war discovery of new sources is tending to make crude oil a world commodity.

Professor W. Bradley proposed the vote of thanks to Mr Paine, who was afterwards entertained to dinner by the Committee.

#### LONDON

*Observations on Analytical Chemistry.* The inaugural meeting of the 1960-61 winter session of the Kent Sub-Section was held at the Medway College of Technology, Chatham, on 25 October. Dr C. E. Seaman, Head of the Science Department at the College, welcomed members and introduced Mr P. A. Raine, Chairman of the meeting.

Mr Raine paid tribute to Mr J. R. Barr, who was retiring from the office of Chairman of the Sub-Section after serving continuously on the committee since its inception, the last four years as Chairman. It was largely due to Mr Barr's efforts that the Sub-Section was formed. He would be succeeded as Chairman by Dr T. Dewing. Mr Raine then introduced the speaker, Dr J. Haslam.

Dr Haslam said he would confine his remarks to three topics, titrimetry, especially potentiometric, colorimetry and gas-liquid chromatography. He began by describing briefly the pioneer work in potentiometry of Dr H. J. S. Sand in 1926 (for example, chloride estimation with a silver electrode), leading to present-day automatic titrimetry. Automatic titrimetry could now be applied not only for straight-forward acid-alkali

titrations but also for the determination of such things as  $\text{NH}_4^+\text{Cl}^-$  and  $\text{Zn}^{2+}$  by the EDTA and Fischer determinations. The determination of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  in water samples proved more difficult, probably because of the  $\text{HCO}_3^-$  present. Prior removal of this ion by boiling led to correct results.

Dr Haslam then went on to describe some of the newer colorimetric methods. He mentioned in particular the determination of phosphates, nitrites by Peach's reaction, the positive method for fluorine (Belcher, Leonard and West) and the use of chloranilates. The determination of small amounts of ammonia by the indophenol and ninhydrin methods and the Saville method for mercaptans were also mentioned.

Dr Haslam ended by describing some new methods of gas-liquid chromatography used in the plastics field.

The lecturer answered many questions in the ensuing discussion. A vote of thanks was proposed by Mr Barr; Mr Raine thanked the College authorities for the facilities afforded to the Section.

*Chemistry of Cancer.* On 7 November a meeting was held jointly with the College Chemical Society at the Woolwich Polytechnic. Mr F. C. Hymas presided, and the lecture was given by Dr W. Davis, of the Chester Beatty Research Institute, who spoke on 'Some Aspects of the Chemistry of Cancer.'

After outlining the aims of chemotherapy of cancer in relation to surgery and radiotherapy, the lecturer described the developments of the 'nitrogen mustard' series of drugs, and other bifunctional alkylating agents including 'Myleran.' The mechanism of action of these drugs was exemplified by studies of the reactions of 'Myleran' with cysteine, and of sulphur mustard gas with the guanine of DNA. Inhibition of normal DNA synthesis was considered also to be the mechanism of action of the anti-metabolites, of which a brief account was given.

Following an interesting discussion, Dr S. R. Landor proposed the vote of thanks to the lecturer, and Mr Hymas thanked the College authorities for the facilities.

*Gastronomic Chemistry.* A joint meeting was held with the Cambridge University Chemical Society on 18 November, 1960, in the Lensfield Road Laboratories, Cambridge. Mr P. A. Raine took the Chair.

In a short introductory address Mr Raine mentioned the continued success of the joint meetings arranged annually in Cambridge, and he extended a welcome to all C.U.C.S. members to attend the meetings of the newly-formed Cambridge Sub-Section of the London Section of the Institute. He then introduced the lecturer, Dr A. McM. Taylor, deputy director of research, British Food Manufacturing Industries Research Association, who spoke on 'Gastronomic Chemistry.'

Explaining his title, Dr Taylor said he proposed to talk about the appeal or palatability of food rather than



the more traditional aspects of food chemistry. He divided his lecture into the three sections which together constituted the main sources of appeal in foods, that is, colour, texture and flavour.

In his discussion on the colour of meat and vegetables, Dr Taylor pointed out that the pigments haem and chlorophyll were related chemically in that they were both derived from porphyrin; he then went on to outline the colour changes of meat associated with the degree of oxygenation of the pigment. This point was brought out by reference to the colour changes possible in the sausage. After dealing with the curing of meat and the associated difficulties due to colour change encountered by manufacturers, attention was directed to vegetable colouring matters. A survey of chlorophyll, carotenoid pigments, anthocyanins and flavones, followed by reference to the measurement of food colour, led on to the subject of 'texture' in foodstuffs.

The toughness or otherwise of meat was related to the proportions of muscle tissue and connective tissue, this being suitably illustrated by the cooking instructions for rump steak on the one hand or for a joint from the leg on the other. The role of calcium and of pectic substances in the texture of plant products was considered, and the practical aspects of control of texture were illustrated by reference to the preservation of strawberries by sulphur dioxide. Dr Taylor emphasized that the measurement of texture was entirely empirical, generally based on the force required for a given deformation.

On the topic of the flavour of foodstuffs, it was pointed out that taste is largely a matter of odour and, furthermore, that there appears to be no correlation between odour and chemical structure. After a short review of essential oils and terpene derivatives, Dr Taylor ended his lecture by referring to difficulties in measurement of flavour as carried out by tasting panels, whereby only a subjective assessment of flavour is obtained.

A spirited discussion followed, after which the proceedings were closed with a vote of thanks proposed by Mr Kirby, Secretary of the Cambridge University Chemical Society.

#### MID-SOUTHERN COUNTIES

*Rocket Propellents.* On 17 November a meeting was held jointly with the Institute of Petroleum at the Municipal College, Bournemouth. Dr W. G. S. Parker, of the College of Advanced Technology, Birmingham, gave a lecture entitled 'Rocket Propellents.'

Dr Parker began his lecture by pointing out that in the past 20 years the rocket has emerged from near obscurity to being a star performer in contemporary science and, while many disciplines are involved in rocket technology, the propellents used so far have been the prerogative of the chemist.

The performance of propellents is usually expressed in terms of the specific impulse,  $I$ , which is the thrust in lb

per lb of propellant consumed per second. The value of  $I$  is, *inter alia*, directly proportional to  $\sqrt{T/M}$ , where  $T$  is the combustion gas temperature and  $M$  is the mean molecular weight of the combustion gas. Two types of chemical reaction may be used to generate the hot gases, as follows:

- (1) Exothermal decomposition of substances such as hydrogen peroxide, hydrazine and propyl nitrate;
- (2) Oxidation reactions between an oxidizer, such as liquid oxygen, nitric acid or fluorine, and a fuel.

Reactions which give the highest heat release are those involving oxygen or fluorine with the light elements, hydrogen, lithium, beryllium and boron, but the specific impulses obtained are limited except for hydrogen by the high enthalpy of vaporization of the oxides (or fluorides) and their high molecular weights. The best fuels are hydrogen and compounds of hydrogen with the light elements including carbon.

At the present time liquid oxygen with a hydrocarbon fuel is most widely used in large rockets for satellite launchings. The value of  $I$  for such a system is approximately 286 sec but higher performance would be achieved with hydrogen and oxygen (385 sec) and with hydrogen and fluorine (400 sec). Systems using liquid ozone or high concentrations of free radicals would have still higher  $I$  values, but many obvious problems need to be solved before these substances can be seriously considered. Dr Parker described the properties of a number of propellents, especially those which cause difficulty in handling. The decomposition type of liquid propellant has a lower performance than the bi-propellant oxidation type, and is not generally employed for the main propulsion of a rocket. This type is extremely useful for auxiliary power generation, however, and in this connection the mechanism of the rapid decomposition of hydrogen peroxide by silver catalysts was discussed.

Dr Parker concluded with a review of solid propellents. Their use leads to rockets which are simpler to handle but of lower performance than liquid-fuelled rockets, not exceeding about 240 sec at the present time. Solid propellents are of two main types: double-base propellents such as cordite, and composite propellents, which are essentially mixtures of an inorganic oxidizer and a fuel. The British plastic propellant used in the Raven Motor of the Skylark sounding rocket is a good example of the latter class. The lecture was well illustrated by slides and the lecturer answered several questions. A vote of thanks was proposed by Mr F. P. Bannister, of the Institute of Petroleum.

*Social Evening.* A film show and sherry party were held at the University of Southampton on 5 December. A most enjoyable evening was spent by the members, visitors and guests.

*Non-Aqueous Titrations.* On 2 December a meeting was held jointly with the Portsmouth and District

Chemical Society at the College of Technology, Portsmouth. The speaker was Mr G. F. Lewis, of British Drug Houses Ltd, and the lecture was entitled 'Non-Aqueous Titrations.'

Mr Lewis commenced by giving a brief historical survey of his subject. One of the earliest reports of work in this field was that of Kahlenburg in 1902, but it was not until 1910 that the analytical significance was first realized by Folin and Wentworth, who published a method for determining fatty acids. Not until the 1950s do we see this technique first being widely used.

The Arrhenius definition of an acid did not explain reactions in non-aqueous solvents, but the Lowry-Brønsted and the G. N. Lewis theories were applied satisfactorily to these reactions.

The lecturer next discussed solvents, and classified them into four groups—aprotic, protophilic, protogenic and amphiprotic. This led to a discussion of titration of basic substances, including descriptions of apparatus and choice of indicator.

The titration of acidic substances was described next, with particular reference to suitable electrode systems. The lecturer spoke of methods that were used in his laboratory and of particular interest, for example, the determination of acetic anhydride in the presence of acetic acid by its reaction with aniline to form the weakly basic acetaniline, and back titration of the excess; and the determination of nickel by chelating with dimethylglyoxime and titrating the liberated hydrogen ions.

Mr Lewis concluded with a short description of the Karl Fischer titration. Mr Lewis's answers to questions put to him showed his strong theoretical and practical knowledge of this intriguing subject.

The vote of thanks was given by Dr R. E. Parker.

#### NEWCASTLE UPON TYNE AND NORTH-EAST COAST

*Analytical Chemistry.* A joint meeting was held with the Society for Analytical Chemistry on 23 November, when Mr H. N. Wilson, of Imperial Chemical Industries Ltd, Billingham Division, lectured on 'The Changing Face of Analytical Chemistry.'

Mr Wilson took as his theme the difference between the science of analytical chemistry and the technology of chemical analysis, pointing out that the methods of the latter are invariably ahead of those of the former. He drew his examples from fields in which he himself has been directly concerned, namely those of micro-chemistry, the development of new reagents and titrations in non-aqueous solutions. There was also a reference to the usefulness of chromatography as a means of separating a complex mixture of condensed phosphate ionic species.

Finally, the ever-increasing influence of physics in analytical chemistry was discussed, in relation to the need for complete automation in factory control analysis. Mr Wilson considered that the more

widespread use of the extremely expensive equipment of emission spectroscopy and, more recently, X-ray fluorescence analysis, was justified in terms of speed and the saving of manpower for more satisfying and productive work.

#### NORTH WALES

*Annual Dinner.* The Seventh Annual Dinner of the Section was held at the Blossoms Hotel, Chester, on 4 November. The guests included Sir William Garrett, M.B.E. (Monsanto Chemicals Ltd, London), Lady Garrett, Mr S. T. Pickering (Chance-Pilkington Ltd, St Asaph) and Mrs Pickering. The attendance at this function was most encouraging, and a very pleasant social occasion resulted.

*Explosives in the Service of Man.* The November meeting was held at Denbighshire Technical College, Wrexham, on 11 November, jointly with the Liverpool Section of the Society of Chemical Industry. The Chairman for the evening was Professor C. E. H. Bawn, C.B.E., F.R.S., of the University of Liverpool. Dr B. D. Shaw, of the University of Nottingham, gave a most instructive lecture, and demonstrated many explosive experiments. The large audience, which included students from grammar schools, had a most enjoyable evening. The Principal of the College, Mr D. C. Morgan, proposed the vote of thanks.

#### SOUTH WALES

*Chemical Control of Plant Growth.* On 17 November, at a joint meeting with the Chemical Society, Professor R. L. Wain, F.R.S., of Wye College, lectured on 'The Chemical Control of Plant Growth' to a large audience, which included numerous visitors from local biological societies. Professor C. H. Hassall presided and, after welcoming members of both societies to the first meeting of the session, introduced the speaker and paid tribute to his pioneer work in this field.

Professor Wain began by considering the many factors which govern the growth of plants. He pointed out that, apart from chemical fertilizers, many substances are now known which, when applied to plants at very low dosage rates, will control and modify their growth. He fascinated his audience with a beautiful collection of coloured slides which so aptly illustrated his examples. He ended his lecture with a discussion of the attempts which had been made to relate chemical structure with physiological activity in compounds of this type.

At the end of the meeting Professor H. E. Street, of the Department of Botany, University College of Swansea, proposed the vote of thanks to the speaker for his outstanding lecture.

*Sherry.* On 25 November, some 65 members and their ladies spent a very enjoyable evening at the University College, Swansea, when Mr M. D. Corbett, of John



Harvey and Sons Ltd, gave a talk on 'Sherry.' The occasion was that of the Section's Ladies' Night, which has become a most popular annual event. The speaker was introduced by the Chairman, Mr R. H. Jones.

By way of an introduction, and to create the atmosphere for what was to turn out to be a memorable meeting, the lecturer showed a short film on the sherry-producing area of Spain. This delightful film gave a close-up of the harvesting of the grapes, the squeezing of the juice by treading (done very hygienically, the workers wearing special nail-studded boots!), the fermenting and the final blending. Mr Corbett then gave a very clear account of the place of sherry in the wine spectrum, and defined a wine as 'the liquor resulting from the fermentation of the juice of freshly-picked grapes.' Speaking as a wine-merchant, he disclaimed any knowledge of the Periodic Table of the Elements below which he had pinned a map of Europe showing the principal wine-growing areas. Nevertheless, he gave a lecture in a manner worthy of the best academic circles as he elaborated the main types of sherry. The majority of his audience were surprised to learn that his firm marketed as many as 37 different types of sherry. He ended his talk with a detailed explanation and demonstration of the art of wine-tasting in which he stressed that the pleasure of wine drinking is enjoyed by



Mr M. D. Corbett (left) pouring out 'first taste' for the Section Chairman, Mr R. H. Jones

the three senses—the eye, the nose and the palate. Mr Corbett then invited his audience to a generous tasting ceremony involving four different types of sherry.

At the end of the gathering, which had drawn members from the fringes of a widely-dispersed section, Dr Islwyn Jones proposed a hearty vote of thanks to the speaker and to his company for their generous co-operation.

#### SOUTH-WESTERN COUNTIES

*Radiochemistry.* The first meeting of the session was held on 14 October in the Technical College, Tavistock Road, Plymouth. The Chair was taken by Mr E.

Winterbottom, Section Vice-Chairman, and the speaker was Mr A. B. Heslop, of the Admiralty Materials Laboratory, Poole.

Radiochemistry, said Mr Heslop, involves the study and application of natural and artificial radioactive materials. As a subject it dates from early in the present century, and great progress had been made by the outbreak of war in 1939, especially after 1934, when artificial radio-elements were first prepared. The invention of the nuclear reactor, however, provided the greatest impetus to development. Radiochemical measurements require the detection of the emitted radiations by means of ionization chambers, scintillation crystals or other devices, and usually entail the counting of individual disintegrations. The radiations concerned may consist of  $\alpha$ - or  $\beta$ -particles, X- or  $\gamma$ -rays, or occasionally neutrons, all of which differ considerably in their powers of penetrating or interacting with matter. Decay is fundamentally a random process, but obeys a simple law such that, subject to statistical variation,  $dN/dt = -\lambda N$ , where  $N$  is the number of active atoms present at any moment and  $\lambda$  is constant for a particular isotope.

Extremely small amounts of active isotopes can be used as labels or 'tracers' in much larger quantities of their elements, and a wide variety of chemical and physical changes can be thus followed with high sensitivity. In many cases amounts of active isotopes down to 10–15  $\mu\text{g}$  or less can be easily detected. Self-diffusion, and exchange reactions of atoms of an element between different molecular species, provides examples of processes which can only be studied by isotopic methods.

Radioactivity can be a powerful analytical tool. It can be employed in isotope dilution analysis (though this is not exclusively a radiochemical technique) for the rapid determination of compounds whose quantitative separation or assay is otherwise extremely laborious. The essence of the method is that quantitative separation of the compound is not required, but only the isolation of a pure fraction. Neutron activation is for many elements a highly sensitive analytical method, in which the elements being sought are activated *in situ* by exposing the sample to a neutron flux. Subsequent chemical operations may be needed to separate required activities in radiochemically pure forms for measurement, but they need not be quantitative if known weights of carriers are first added, and there is no 'reagent blank' problem.

Tracers have been extensively used in studying organic reaction mechanisms and biological processes, particularly metabolic pathways. Many labelled organic compounds are marketed by the Radiochemical Centre, Amersham.

Geological dating by radioactivity is now proving to be a very powerful and useful technique, particularly with  $^{14}\text{C}$ .

Techniques of measurement still largely involve the ionization chamber, but the scintillation counter has rapidly gained ground as an efficient and selective means of measuring  $\gamma$ -radiation.

There was an interesting discussion, and the meeting concluded with the vote of thanks proposed by Dr A. B. Meggy (who also acted as projectionist). An informal dinner was afterwards held in the Crescent Hotel.

*Scientific Organization of Chemical Inspection.* On 11 November, at the Washington Singer Laboratories, University of Exeter, Mr E. W. Press, C.B.E., Director of Chemical Inspectorate, War Office, delivered a lecture on 'The Scientific Organization of Chemical Inspection.' Mr T. W. Parker was in the Chair.

Mr Press dealt with the functions, organization and present policy underlying the day-to-day work of the Chemical Inspectorate, a unique organization in the world of chemistry which has recently again become a War Office Establishment. He gave its Terms of Reference or Charter, and described its relationship with the other Inspectorates in the War Office and Ministry of Aviation, all of which were formerly in the Ministry of Supply. He explained how the Chemical Inspectorate was integrated with these Inspectorates, and its particular responsibilities with regard to materials inspection. He pointed out that it was also a Research and Development Establishment responsible particularly for research and development on paints and allied products, temporary protectives and analytical methods and chemical analyses of all descriptions.

The headquarters of the Chemical Inspectorate is at Woolwich Arsenal, and it has many laboratories throughout the United Kingdom. The staffing and organization developed to control the work throughout the Establishment, including research and development on analytical methods and instrumental techniques, were described in detail.

The vote of thanks was proposed by Mr F. J. Armstrong. Members and guests afterwards attended an informal dinner at the Royal Clarence Hotel, at which Mr Press was guest of honour.

#### THAMES VALLEY

*Forensic Science.* On 14 October Mr L. C. Nickolls, of the Metropolitan Police Laboratory, New Scotland Yard, gave a lecture on the development of forensic science at a joint meeting of the Section and the Reading University Chemical Society.

He pointed out that in British justice it is axiomatic that the onus is on the prosecution to prove beyond all reasonable doubt the guilt of the accused and that, in every race and society, courts endeavour to satisfy themselves as to the guilt of the accused. Mr Nickolls traced the development of scientific knowledge through the last two centuries and its applications to resolving the question of proof. At first the impetus came from

medical practitioners (Orfila, 1800) and, later, use was made of the analytical techniques developed by Public Analysts. Since then, steady progress has been made in the application of practical techniques in all branches of science to the question of obtaining proof. Regional forensic science laboratories were set up in 1935, following the recommendations of Lord Trenchard's Committee of 1930, to provide scientific aid for the Police Forces. These constitute a pool of scientific knowledge and reliable information which is available to assist the court to arrive at a proper verdict.

Mr Nickolls illustrated, with the aid of numerous slides and quotations of cases, the four fundamental corner-stones of forensic science required to give maximum aid to the administration of justice. He considered these to be (a) keen and correct observation, (b) the experience or expertise to identify and assemble such scientific facts as are of interest in any particular case, (c) access to scientific information of all kinds and (d) the availability of scientific instruments.

Mr Nickolls gave a very complete picture of how a scientist, by use of scientific methods and instruments, can obtain information which cannot be obtained in any other way, which is measurable and therefore accurate and adds materially to the certainty of proof. He stressed the fact that, although instruments can be extremely valuable, the man behind them is of far more importance than the machine, which is merely a tool in his hands. Every technique suffers from a limitation, which is the summation of the limitations of the machine and operator.

Mr D. T. Lewis, Chairman of the Section, proposed the vote of thanks.

*Annual General Meeting.* After this meeting the A.G.M. was held, when the following were elected to the Committee: Chairman, Dr F. M. Brewer, M.B.E.; Deputy Chairman, Dr P. F. Holt; Hon. Secretary, Dr A. D. Jenkins; Hon. Asst Secretary, Dr F. H. Grimbleby; Hon. Recorder, Mr J. A. Radley; Members of Committee, Messrs L. Airey, W. E. Hanby, F. A. Lyne and D. H. McLean.

*Esso Refinery.* On 21 October a party visited the Esso Refinery, Fawley, after a pleasant motor coach journey, and were conducted round the Refinery in the coach. The layout of the Refinery, the processes performed and methods of operation were explained. Refreshments were provided by the Company, and members of the party were able to discuss matters of interest and ask questions of the Company's personnel. This most interesting visit was concluded by a vote of thanks to the Company for their hospitality.

*Oxford Meeting.* A meeting was held in the Inorganic Chemistry Lecture Theatre of the University of Oxford on 25 October, 1960, jointly by the Section and the



Society for Analytical Chemistry. It was opened by Dr R. E. Richards, F.R.S. (Lincoln College, Oxford) who outlined the origin of nuclear magnetic resonance spectra and the underlying theory. Dr J. E. Ferrett (A.E.R.E., Harwell) then spoke on the application of the technique to inorganic analysis and Dr L. M. Jackman (Royal College of Science, London) spoke of its use on resolving problems in organic chemistry.

*Children's Evening.* On 2 November the Children's Evening of the Section was held at the University of Reading. Some 400 children attended, and were addressed by Mr R. G. Hall, Chief Chemist of Brocks Fireworks Ltd, on 'The History of Fireworks.'

After discussing the history of the subject, Mr Hall gave demonstrations of firework making and of indoor fireworks, emphasizing the great skill necessary to carry out the various operations without danger or mishap. A large amount of chemical information of interest to children was given throughout the lecture. At the conclusion of the indoor lecture and demonstration, Mr J. A. Radley thanked Mr Hall on behalf of the audience. The meeting was followed by an outdoor display of fireworks.

#### EAST AFRICA

*Organic Reagents for Analysis.* On 28 September, Professor M. Crawford took the Chair for a meeting held in the Department of Chemistry, Makerere College. Mr W. C. Johnson, M.B.E., Technical Director, Hopkin and Williams Ltd, delivered a lecture on 'Recent Advances in Organic Reagents for Analysis.'

For his address, Mr Johnson adopted an historical treatment that revealed a steady progress from the haphazard and often fortuitous discoveries of earlier times to the more deliberate and calculated approach of modern investigators. The parts played by chelation and co-ordination are now well realized, and the influence of substitution of various elements and groups in a number of skeleton structures has been established and exploited in the development of new and improved reagents. Dimethylglyoxime has thus become the parent of several other reagents, such as nioxime, heptoxime and 4-methylnioxime, which exhibit greater sensitivity for nickel and higher solubility in water.

2,2'-Dipyridyl and 1,10-phenanthroline possess very similar characteristics as colorimetric iron reagents by

virtue of the  $\text{=N-C}\equiv\text{C-N=}$  chain which is common to both substances. Substitution that produces a

$\text{CH}_3\text{-C}\equiv\text{N-C}\equiv\text{C-N-C}\equiv\text{N-CH}_3$  chain (in which the  $\text{CH}_3$  groups may be linked with further substituents) yields a series of sensitive and selective copper reagents that give no reaction for iron. This series includes 2,2'-diquinolyl and 2,9-dimethyl-1,10-phenanthroline. Substitution by phenyl groups at the 4 and 7 positions

of 1,10-phenanthroline leads to enhanced sensitivity, and 4,7-diphenyl-1,10-phenanthroline is twice as sensitive for iron as the parent substance; 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline is selective for copper with a molecular extinction coefficient of 14,160. The number of compounds in this class prepared and examined by Close and Smith and other investigators approaches 200.

Two reagents may be regarded as evolved from 8-hydroxyquinoline. These are 8-hydroxyquinoline, which is a little more selective than 8-hydroxyquinoline in that it gives no precipitate with aluminium, and 2-(*o*-hydroxyphenyl)benzoxazole, which is a selective reagent for cadmium and copper.

Toluene-3,4-dithiol has long served as a reagent for tin, tungsten and molybdenum but its instability has constituted a practical disadvantage. R. E. D. Clark has introduced stable derivatives, the zinc complex and the diacetyl compound, from which the dithiol is readily generated, and he has extended its uses to the detection and identification of 34 thiophyllic cations.

Thioacetamide has several advantages over hydrogen sulphide in the precipitation of metallic sulphides. In particular, it lends itself to the technique of precipitation in homogeneous solution, which is currently attracting considerable attention. Several examples of the use of this principle were discussed.

Metalochromic indicators play an essential part in the complexometric titration of metals with EDTA, and the development of these reagents was reviewed under two main group headings. A number of azo dyes with phenolic hydroxy groups *ortho* to the azo linkage fall in the first group. These are further substituted so as to influence suitably the chelating properties with the various metals concerned. A second and more recent series results from introducing one or more amino-methyl-*NN*-diacetic groups into various phenolic indicators, such as the phthaleins and sulphonphthaleins. The resulting compounds are thus endowed with chelating properties operating through a mechanism similar to that exercised by EDTA itself.

The chloranilates of several metals have found application to the indirect colorimetric determination of certain acid radicals in low concentrations. The reaction is one of double decomposition, which sets free a stoichiometric proportion of the highly-coloured chloranilic anion, and this is determined photometrically. Thus, lanthanum or thorium chloranilate affords a method for fluoride, barium chloranilate one for sulphate and mercuric chloranilate for chloride. The fluorone series of reagents fills a number of gaps in colorimetric analysis. The first to be introduced, methyl fluorone, yields an intense red colour with antimony. This was followed by the germanium reagent, phenyl fluorone and later by 9-(3'-nitrophenyl)-2,3,7-trihydroxy-6-fluorone for zirconium and 9-(4'-dimethylaminophenyl)-2,3,7-trihydroxy-6-fluorone for tantalum.

Attention was also drawn to a miscellaneous selection of reagents such as thorin for thorium, zincon for zinc and copper, *p*-bromomandelic acid, which is a gravimetric reagent for zirconium, and uranol, which yields a blue colour with uranium in concentrations down to one in five million. Glyoxal bis-(2-hydroxyanil) is a long-sought selective colorimetric reagent for calcium for both qualitative and quantitative application.

*Oil Products.* Dr C. G. Williams, general manager and director of research of Shell Research Ltd, was the speaker on 9 November at a meeting held in the Department of Chemistry, Makerere College. Members and visitors heard an interesting survey of the 'Research and Development of Oil Products.'

Research in the oil industry is carried out in laboratories which range in size from 100 to 2,000 staff, with an expenditure of about 1 per cent of sales. About three-quarters of the programme is developed as a result of contact with the marketing and manufacturing departments, and the remainder is basic or long-term work.

An important feature of research on oil products is the deleterious effect of certain non-hydrocarbon components such as sulphur, nitrogen, copper and so on, which are, so far as possible, removed, although this cannot be done with the sulphur in fuel oil. On the other hand, beneficial properties can be given to oil products by the use of chemical additives, of which there are a large number with a diversity of properties, for example ignition inhibitors, surface-active agents, oxidation inhibitors and so on. Research is now being carried out on so-called multi-functional additives, which can be long-chain molecules with side chains that confer various beneficial properties.

Continuing research on oil products is necessary in order to meet the increasing demands of industry, and examples of this are the development of turbine fuels of low flame luminosity, turbine fuels for supersonic aircraft, motor spirit of higher anti-knock value and non-ash motor lubricants with improved properties. Another problem which is being studied relates to the generation of static electricity when fuels are pumped at high speed. An additive has been developed which largely eliminates the risk of explosions.

An interesting development is the 'Fuel Cell,' which can generate electricity at high efficiency. This may become important, and research is therefore being carried out to ascertain what kind of fuel it may require.

*Organic Chemistry.* On 18 November the Section welcomed Professor W. J. Hickinbottom, who gave a lecture in the Department of Chemistry, Makerere College, on 'Newer Methods of Organic Chemistry.'

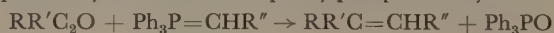
The use of diborane as a reagent in organic chemistry is a very recent introduction. It can be used as a reducing agent, but its main application is the formation of trialkylboranes by addition to olefins. These trialkylboranes can be oxidized to alcohols by alkaline

hydrogen peroxide, so that the method may be used as an alternative route for converting olefins to alcohols. It is of considerable importance since  $\alpha$ -olefins, except for the styrenes, yield primary alcohols as the main product. Furthermore, other olefins yield trialkylboranes, which isomerize on heating to give products yielding primary alcohols by oxidation.

Diborane also adds to acetylenes in suitable conditions; if the adduct is decomposed with acetic acid, an olefin is formed. The reduction is stereospecific.

Other methods of reduction discussed were the reduction of olefins by addition of lithium aluminium hydride or of alkyl aluminium hydrides, and subsequent decomposition of the adduct. The use of sodium or of lithium in liquid amines was described—and it can be applied as a powerful reducing agent for aromatic systems and even for olefins.

Another recent development of considerable importance is the Wittig reaction—a method of converting carbonyl compounds into unsaturated compounds by reaction with triphenylphosphine alkylidenes.



#### WESTERN INDIA

*Quality Control of Milk.* On 14 October Mr Khurody, dairy development commissioner of the State of Maharashtra, addressed the Section on 'Quality Control of Milk and Milk Products.' Dr H. S. Mahal was in the Chair. Mr Khurody detailed the various process-control measures taken at the procurement stations, at the dairy and storage plants and finally at the distribution centres to ensure that the consumer got a product of guaranteed quality. He indicated the difficulties in adopting very rigid quality-control tests for milk for the entire state. He also pointed out the lacunae in the food adulteration Act, and the difficulties the inspecting staff had to face in enforcing the Act.

*Chemicals in Perfumery.* On 24 November, Professor V. M. Bhawe, of the Ram Narain Ruia College, addressed the Section on 'Aromatic Chemicals and Isolates in Perfumery,' under the Chairmanship of Dr H. S. Mahal.

Professor Bhawe gave an exhaustive list of the aromatic chemicals and isolates normally used in the perfumery trade, and said that some of these could be successfully prepared even as a cottage industry by any good student of organic chemistry. He indicated that with the steadily improving living standards in the country, the perfumery trade might have an ultimate turnover of about Rs 200 crores per year even at a modest expenditure of Rs 5s. per head on these items, and emphasized that, thanks to the steady imposition of foreign exchange curbs on these luxury items, the field is open to Indian chemists to prove themselves.



# News and Notes

## COURSES

**Kingston Technical College.**—Two postgraduate lecture courses have been arranged by the department of chemistry, biology and geology of the College, on 'Chemical Spectroscopy' and 'Theories of Valency—a correlation of modern ideas.' Further details may be obtained from Mr J. H. Waton, senior lecturer in chemistry, Kingston Technical College, Fassett Road, Kingston upon Thames, Surrey.

**Postgraduate Courses.**—The Department of Extra-Mural Studies, University of Liverpool, has published a leaflet giving details of non-residential and residential postgraduate courses, including those on fundamental processes of gaseous discharges, industrial thermodynamics and practical chromatography, which will be held in the spring. The leaflet is obtainable from the Director of the Department, 9 Abercromby Square, Liverpool, 7.

**Summer School in Physical Chemistry.**—A Summer School on 'Fast Reactions' will be held in the department of physical chemistry, University of Cambridge, on 12–19 August. Among those contributing to the programme of lectures will be Professor R. G. W. Norrish, F.R.S., Dr A. G. Gaydon, F.R.S., and Dr T. M. Sugden. Full opportunity will be provided for discussion. The main objects of the course are to bring up to date and extend the knowledge of scientists working on subjects allied to physical chemistry, and to bring together those in industry and teaching. Further details may be obtained from the Secretary of the Summer School, Department of Physical Chemistry, Lensfield Road, Cambridge.

## MEETINGS AND CONFERENCES

**Combustion Research Colloquia.**—Visitors are welcome to attend the Colloquia in the Department of Chemical Engineering and Chemical Technology, Imperial College of Science and Technology, of which five have been arranged for the Spring Term, 1961. The second of these will be held at 4 p.m. on 6 February, when Dr G. Munday will speak on the propagation of gaseous detonations under marginal conditions. Further details can be obtained from Dr J. H. Burgoyne, Department of Chemical Engineering and Chemical Technology.

**High Polymer Research Group.**—The High Polymer Research Group has been founded under the Chairmanship of Sir Harry Melville, K.C.B., F.R.S., for the purpose of organizing study conferences. The first conference will be held on 17–20 April, and will consider the relationship between chemical structure and

physical properties of elastomers. The policy of the Group is to encourage the free exchange of ideas between active workers from all countries in the chosen field, and for that reason participation will be by invitation only. The offices of the Group are at 14 Belgrave Square, London, S.W.1.

**Mass Spectrometry Conference.**—The Mass Spectrometry Panel of the Institute of Petroleum, in conjunction with A.S.T.M. Committee E-14, are organizing a conference on Mass Spectrometry, which will be held at the University of Oxford on 12–15 September. Papers dealing with any aspect of mass spectrometry will be welcome, but there will be special sessions on high-resolution mass spectrometry and the mass spectrometry of organic compounds and of inorganic solids. Those wishing to present papers at the Conference should send full abstracts by 28 February to Dr R. R. Gordon, Chairman, Mass Spectrometry Panel, National Coal Board, Coal Research Establishment, Stoke Orchard, Cheltenham. Details of Conference membership and all other arrangements can be obtained from the Organizing Secretary, Mr W. J. Brown, Instrumentation Division, A.E.I. (Manchester) Ltd, Trafford Park, Manchester, 17.

**Microchemical Techniques.**—The International Symposium on Microchemical Techniques, organized by the Metropolitan Microchemical Society and sponsored by IUPAC, will be held at the Pennsylvania State University, U.S.A., on 13–18 August. The technical programme will consist of a number of main introductory lectures and a full schedule of invited papers on new methods and techniques and unique applications of microchemical or microanalytical interest. Further details may be obtained from Mr H. J. Francis, Jun., Vice-Chairman, International Symposium on Microchemical Techniques, c/o Pennsalt Chemicals Corporation, Post Office Box 4388, Philadelphia 18.

**Nuclear Magnetic Resonance Spectroscopy.**—An introductory symposium on 'The Chemical Applications of Nuclear Magnetic Resonance Spectroscopy' will be held at the Bradford Institute of Technology on 27–28 January. The speakers will include Drs D. F. Evans, J. Feeney, D. W. Jones, N. Sheppard, J. A. S. Smith and I. M. Ward. There is a registration fee of £2 5s. Further information may be obtained from the Registrar, Bradford Institute of Technology, Bradford, 7.

**Scientific and Technical Conferences.**—The D.S.I.R. have issued a further list (No. 28—January, 1961) of *Forthcoming International Scientific and Technical Conferences*. The aim of the list is to cover all scientific and technical conferences of an international character held in the U.K. and elsewhere, of interest to British Government departments, British Government-supported research laboratories and other scientific organizations.



## NATIONAL COLLEGE OF FOOD TECHNOLOGY

The Duke of Edinburgh opened the new college buildings of the National College of Food Technology at Weybridge on 16 December. Among those present at the ceremony were Sir David Eccles, Minister of Education; Earl Waldegrave, Parliamentary Secretary to the Ministry of Agriculture, Fisheries and Food; Sir Frank Shires, Chairman of the Board of Governors; Sir John Hammond, Vice-Chairman; and Dr J. D. Mounfield, Principal of the College. Miss M. Olliver represented the Institute in her capacity as member of the Board of Governors.

The National College of Food Technology was established in 1951 by the Ministry of Education in co-operation with the food industry. It started in London, but the work expanded so rapidly that the facilities proved inadequate after the first few years. The new college was completed in the summer of 1959 and came into use immediately. It is now an attractive modern establishment, set in its own grounds and with its own residential and communal facilities. The college buildings connect with the earlier mansion and the whole comprises four groups—administration, science laboratories, food processing laboratory and the communal and residential blocks.

Some £50,000 of the total cost (£350,000) was paid by contributions from British food-trade firms, and the college can now accommodate up to 150 full-time students, with residential accommodation for 80, mainly in single bedrooms.

The processing and science laboratories now have facilities for the practical study of all the major food processing operations, such as freezing, drying, canning, emulsifying, refining, milling, baking, pasteurizing and sterilizing.

A large assembly hall, a lecture theatre, refectory, library, reading rooms and common rooms are among its amenities.

**Approved Names.**—The General Medical Council has published a supplementary list of Approved Names, dated November, 1960. The list is available from the Secretary, British Pharmacopoeia Commission, 44 Hallam Street, London, W.1.

**Visitors to the U.K.**—Among those who are at present in this country or are expected to arrive shortly are: Dr P. A. Robins, lecturer in organic chemistry, University College of Rhodesia and Nyasaland (until 5 February); Murray J. Shear, chief of the laboratory of chemical pharmacology, National Cancer Institute, Bethesda (12–19 February); Professor G. Koelle, Professor of Pharmacology, University of Pennsylvania (14–24 February); and M. L. Karmovsky, Harvard Medical School (5–8 March).

## Correspondence

### HOW DOES THE PERIODIC TABLE BEGIN?

SIR,—Your correspondent (J., 1960, 451) considers, quite correctly in my belief, that hydrogen should be classified in the Periodic Table, if indeed it need be classified at all, according to its tendency either to lose an electron, *i.e.* resembling group 1A, or to gain an electron, *i.e.* resembling group VII.

This criterion, however, bears out Professor Guggenheim's argument that hydrogen should be placed in group VII. The hydrogen ion  $H^-$  is much more stable than the  $H^+$  ion and indeed the very existence of a proton, except under extremely energetic conditions, is doubtful. The electronic environment of the hydrogen nucleus in water (a solvated proton), bears no resemblance to that of a free proton and in fact the distribution of charge about the nucleus will tend to approach more nearly to that of a  $H^-$  ion owing to the orientation of solvent dipoles about the proton centre.

W. J. EILBECK,  
*Student Member*

University College of North Wales,  
Bangor

SIR,—Professor Guggenheim's letter on the position of hydrogen in most publications of the Periodic Table suggests this element should be assigned to group VII rather than to group I.

I find that in explaining the Periodic Table to beginners the subject is much better understood if the usual tabular form of the Table is regarded as a plane projection of a cylinder. If it is assumed that a descending spiral line connects the elements in order of ascending atomic numbers upon such a cylinder, the horizontal relationships, as well as the more obvious vertical relationships, are more clearly seen.

This idea might be bettered by considering the Table to be the projection of a cone—one reason being the arrangement of the elements in the long periods. Professor Guggenheim's suggestion would seem to substantiate the idea of hydrogen occupying the apex of this cone, when the relationship of hydrogen to the halogens, as well as to the alkali metals, would become apparent. No doubt any supporters of Prout's Hypothesis could claim links between hydrogen and any other group they chose!

I appreciate that this over-simplification of the matter is subject to imperfections but it has often made things clearer to elementary students of the Periodic Table.

(Mrs) R. I. SILVERTHORNE

3, Penwerris Court,  
Great West Road,  
Hounslow, Middlesex



## MASLIN

SIR,—Partridge's etymological dictionary describes this as a dialect word. Chambers's *Dictionary* states that the following variations of the word are used in Scotland : *mashlam, mashlim, mashlin, mashloch, mashlum*.

There seem to be matters here for consideration by the Local Sections.

Both the books I have mentioned give the meaning of the word as a mixture of grains. The *Shorter Oxford English Dictionary* also gives that meaning (among others). It also states that the use of the word to mean a mixture or medley is obsolete.

Apparently this is now no longer the case.

A. J. V. UNDERWOOD

38, Victoria Street,  
London, S.W.1

## LABORATORY RISKS AND SAFEGUARDS

## Opening of Sealed Ampoules

SIR,—We have recently had what could have been a somewhat dangerous accident whilst opening a small ampoule of isoprene (b.p. 37°C at atmospheric pressure). A deep groove was cut with a diamond around the top of the ampoule about  $\frac{1}{2}$  in. from the end, the ampoule was wrapped in a cloth and an attempt was made to knock the tip of the ampoule off. On striking the ampoule, however, the bottom part shattered and the contents poured out. The thickness of the glass varied from 1.7 to 4.6 mm.

This is the first time we have had any trouble in the opening of sealed ampoules containing a wide range of materials.

G. H. FOXLEY

Sterling Moulding Materials Ltd,  
Castle Mill, Dale Street,  
Stalybridge, Cheshire

## THE REGISTER

## NEW FELLOWS

- (OH) CHATTERJEA, Jnanendra Nath, D.SC.(PATNA), D.PHIL.(OXON.)
- (OH) CHOUDHURY, Pijush Kanti, M.SC., D.PHIL.(CALC.)
- (P) DIN, Fazul, B.SC., PH.D.(LOND.), A.R.C.S.
- (O) HOLLIDAY, Arthur Kenneth, B.SC., PH.D.(LEEDS)
- (Y) JENKINS, Ivor Lloyd, B.SC., PH.D.(WALES)

## ASSOCIATES ELECTED TO THE FELLOWSHIP

- (H) ADDISON, William Eric, B.SC.(GLAS.), PH.D.(ABERD.)
- (SS) ANDERSON, Richard Quintin, B.SC.(GLAS.), A.R.C.S.T.
- ANTONIS, Arnold, B.SC.(RAND), PH.D.(CAPE T.)
- (P) AUSTIN, George John
- (P) BAMFORD, Clement Henry, M.A., PH.D., SC.D.(CANTAB.)
- (P) BEESLEY, Jack Antony, B.SC.(BIRM.)
- (P) BLENFORD, Don Egon, B.SC.(LOND.)
- (Y) DAVIS, Harry Charles, B.SC., B.SC.ENG.(LOND.)
- DEMIKLOUHO-MACLAY, Robertson Wentworth, B.SC.(LOND.), M.SC.(N.S.W.), A.R.A.C.I., DIP.ED.
- (P) DONBROW, Max, B.SC., B.PHARM., PH.D.(LOND.), F.P.S.

- (L) FRANKS, Felix, B.SC., PH.D.(LOND.)
- (C) FREKE, Anthony Marshall, B.SC.(LOND.)
- (P) GARDNER, William Frank, B.SC.(LOND.)
- (Y) HALSALL, Thomas Gilbert, M.SC., PH.D.(MANG.), M.A.(OXON.)
- JELLINEK, Hans Helmut Gunter, PH.D.(LOND.), PH.D.(CANTAB.), D.L.C.
- (S) JOBSON, Harry Taylor
- KHAN, Nurul Absar, M.SC.(Dacca), PH.D.(OHIO)
- (P) MARTIN, Harold Walter, LL.B.(LOND.), F.P.S.
- MORETON, Trevor Gardner
- (O) NEWCOMBE, Raymond John, M.SC.(LOND.), A.INST.P.
- (K) PAYNE, Douglas Sutherland, B.SC.(LOND.), PH.D.(CANTAB.), A.R.C.S.
- RAHMAN, Prof. Aziz-ur, M.SC.(LUCK.), PH.D.(ALIG.), DR.RER.NAT.(TUBINGEN)
- (OF) RAJAN, Thirukudanthai Parthasarathy Soundara, B.SC.(ANNAM.), M.SC.(BENARES), PH.D.(GLAS.), A.R.C.S.T., M.INST.GAS E., M.INST.F.
- (P) SCOTT, Jean Leslie, B.SC.(LOND.)
- (K) SHAW, Andrew, B.SC.(LOND.)
- (OE) SUBRAMANIAN, Sthanu Subramania Sankara, D.SC.(AND.)
- (P) WALL, William, B.SC.(LOND.)
- (O) WARD, William
- (OB) WELLS, Norman Henry, B.SC.(LOND.)
- (P) WINDASS, John Robert, B.SC.(LOND.)

## NEW ASSOCIATES

- AKISANYA, Akitunde, B.SC.(LOND.)
- (OF) BHATT, Jashbhai Girjashanker, B.SC., B.SC.TECH.(BOM.), PH.D.(MANG.)
- BREHAUT, Roger Newbury, B.SC.(BRIST.)
- (P) BUTLER, Anthony Robert, B.SC.(LOND.)
- (Y) CONNICK, Wynford, M.SC.(WALES)
- (Q) DAVIES, Walford Owen, B.SC.TECH., PH.D.(MANG.)
- (OK) D'COSTA, Joseph Francis Xavier Edward, B.SC.(BOM.)
- (G) GODSON, Harold Frederick, B.SC.(EDIN.)
- (OE) GURUSWAMY, Venkataswamy, M.A., B.SC.(ANNAM.)
- (OB) HERLEY, Patrick James, M.SC.(RHODES)
- (P) HUTCHISON, Henry Peter, M.A.(OXON.)
- (OH) IENGAR, Haravu Vardaraj Ramprasad, M.SC.(DELHI), PH.D.(GLAS.)
- (P) JONES, Leslie Rees, B.SC.(LOND.)
- (R) MANSELL, Richard Ivor, B.SC.(LOND.), A.R.C.S.
- (OA) ONG, Soon Hock Augustine, M.SC.(MALAYA)
- PITTET, Alan Owen, B.SC., PH.D.(BRIST.)
- (OH) SANYAL, Anupam, B.SC.(CALC.), M.SC.TECH.(CALC.), PH.D.(SHEFF.)
- (O) SCOTT, Brian Alexander, B.SC., PH.D.(DURH.)
- (P) SHERMAN, Warren Vincent, B.SC.(LOND.)
- (P) SHORT, David John, B.A., B.SC.(OXON.)
- (OH) SUR, Roma, M.SC., D.PHIL.(CALC.)
- (OE) VENKATA RAMAN, Prof. Hedathale Srinivasaiah, B.SC.(MYS.), D.PHIL.(OXON.)
- (OD) VENKATESWARA RAO, Akella Sree, M.SC.(AND.)
- (OF) VORA, Jayantilal Virchand, B.SC.(POONA), B.PHARM.(GUJAR.), PH.D.(LOND.)
- (V) WILSON, Edward McKenzie, B.A.(CANTAB.)

## GRADUATE MEMBERS ELECTED TO THE ASSOCIATESHIP

- (T) BRADBURY, John, B.SC.(WALES), DIP.ED.
- (P) CLITHEROW, John Watson, B.SC.(MANG.)
- (N) COWARD, Malcolm Peech
- (S) CURRAN, Peter Richard
- (O) DELVES, Raymond Bromhall
- (C) DOHERTY, Stanley James
- (P) ENGLISH, Robert James, M.SC.(MANG.)
- (P) GROVER, Philip Leslie, M.SC.(LOND.)
- (P) HINGE, Derek Colin, B.SC.(LOND.), A.R.C.S.
- (SS) INGLEBY, Bryan Edward
- (S) LANGLEY, Robert
- (P) LONG, Michael John, B.SC.(LOND.), A.R.C.S.
- (P) LONG, Ronald Frank, M.SC.(LOND.)
- (P) LORD, Peter Sydney
- (SS) MARSDEN, Frederick John, B.SC.(LIV.)
- (O) NELSON, Gustave
- (P) OTTER, Geoffrey Ernest



- (B) OWENS, John Holland Alwyn, B.SC.(BELF.)  
 (E) PETER, Peter John, B.A.(OXON.)  
 (D) SHARPE, Albert Williamson, B.SC.(LOND.), M.SC.TECH.  
 (MANG.), A.M.INST.F.  
 (O) THOMAS, Graham Robert  
 (J) THOMSON, James, A.H.-W.C.  
 (V) TUCKER, Raymond John  
 (C) VILLIERS, Ralph Frederic, A.T.I.  
 (O) WEBSTER, Brian Robert, B.SC.(LIV.)  
 (O) WILSON, Kenneth

## NEW GRADUATE MEMBERS

- (P) ADAMS, Douglas Brian, B.A.(OXON.)  
 (P) BAXTER, Roy George Colin, DIP.TECH.  
 (P) BLACKLER, Terrence Claude, B.SC.(LOND.)  
 (P) BROWN, Ronald Alexander, DIP.TECH.  
 (Q) ECKERSLEY, Alan, B.SC.(LIV.)  
 (P) EVANS, David Charles, B.SC.(LOND.), A.R.C.S.  
 (A) FRASER, George Alfred, A.H.-W.C.  
 (T) GABBOTT, Peter Anthony, B.SC.(WALES)  
 (P) GARLAND, John Hugo Neill, B.SC.(LOND.)  
 (C) GILL, David, B.SC.(BIRM.)  
 (E) GRIFFITHS, William, B.SC.(WALES)  
 (P) GRIMWOOD, Brian Edwin, B.SC.(LOND.)  
 (U) GRUNDY, Kenneth Henry, B.SC.(MANG.)  
 (C) GUEST, John Harry, DIP.TECH.  
 (P) HAWKES, James Christopher, DIP.TECH.  
 (O) HORNE, Michael Henry, B.SC.(WALES)  
 (S) KIRKBY, Ernest Arnold, B.SC.(DURH.)  
 (P) KONIG, Jacques Marcel, B.SC.(LOND.)  
 (P) LESTAS, Andreas Nicolaou, B.SC.(LOND.)  
 (P) LETON, Garrick Barilec, B.SC.(LOND.)  
 (O) McADAM, Brian William, B.SC.(WALES)  
 (P) McDONALD, Walter Stanley, B.SC.(LOND.)  
 (Q) ORRELL, Keith Gilbert, B.SC.TECH.(MANG.)  
 (Q) PARKINSON, Alan Richard, M.SC.TECH.(MANG.), A.M.C.T.  
 (FF) PETERS, David Albert Vernham, B.SC.(ST AND.)  
 (X) SCUFFHAM, James Barrie, B.SC.(DURH.)  
 (Y) WARRELL, David Charles, B.SC.(LOND.)  
 (C) WATSON, Sonia Jonquil, B.SC.(LOND.)  
 (P) WILLIAMS, John Herbert, DIP.TECH.  
 (D) ZOBEL, Frank George Reinhardt, B.SC.(BRIST.)

## CHANGE OF NAME ON MARRIAGE

Renate Ursula BORN to KOENIGSBERGER, *Follow*

## DEATHS

## Fellows

- (WW) BECKETT, Ernest George, DIP.L.CHEM., PH.D.(ZURICH). Died 27 November, 1960, aged 77. *F.* 1917.  
 (N) BRACEWELL, Geoffrey Alfred. Died 22 November, 1960, aged 72. *A.* 1915, *F.* 1918.  
 FEITELSON, Bruce Norman, B.SC., PH.D.(LOND.). Died 4 December, 1960, aged 35. *A.* 1946, *F.* 1956.  
 (P) GARLAND, Charles Samuel, B.SC.(LOND.). Died 4 December, 1960, aged 73. *A.* 1909, *F.* 1919.  
 (P) GRIFFITHS, Philip Morley, B.SC.(WALES). Died 21 November, 1960, aged 59. *A.* 1923, *F.* 1937.  
 (P) HOWARD, Bernard Farmborough. Died 19 November, 1960, aged 80. *A.* 1904, *F.* 1907.  
 (O) KIRBY, Denis, B.SC.(LOND.). Died 10 November, 1960, aged 52. *A.* 1933, *F.* 1943.  
 (N) MILLER, James McPherson, M.SC.(MANG.). Died 21 November, 1960, aged 69. *F.* 1918.  
 (V) PHILLIPS, David Luther, M.SC.(WALES). Died 21 November, 1960, aged 69. *A.* 1918, *F.* 1943.  
 (P) SIMMONS, William Herbert, B.SC.(LOND.). Died 3 December, 1960, aged 80. *F.* 1917.  
 (O) THOMAS, Richard, D.SC.(WALES). Died 25 November, 1960, aged 71. *A.* 1918, *F.* 1924.

## Associates

- (Q) CHOATE, Matthew Francis Stephen, B.SC.(DURH.). Died 7 August, 1960, aged 74. *A.* 1918.  
 (O) LIPTROT, George Ashurst. Died November, 1960, aged 48. *A.* 1948.

## LOCAL SECTIONS DIARY

All times are p.m. except where otherwise stated. For key to Local Sections see *J.*, 1960, 416.

- (A) **Aberdeen.** 20 Feb. 8. Chemical Society Pedler Lecture. Prof. R. D. Haworth. Chemistry Department, The University. Joint, C.S. and S.C.I.  
 (V) **Aberystwyth.** 9 Feb. 6. Biosynthesis of Terpenoids with special reference to Carotenoids. Prof. T. W. Goodwin. Department of Agricultural Chemistry, Institute of Rural Science, Penglais. Joint, University College of Wales Chem. Soc.  
 (B) **Belfast.** 27 Jan. Annual Dinner. Joint, C.S. and S.C.I.  
 — 23 Feb. 7.45. The Principles of Radiation Chemistry and the Possibilities of its Industrial Application. Prof. F. S. Dainton. Chemistry Lecture Theatre, Queen's University, Stranmillis Road.  
 (X) **Billingham.** 15 Feb. 8. Some Developments in Analytical Chemistry. Prof. R. Belcher. Stockton and Billingham Technical College.  
 (C) **Birmingham.** 14 Feb. 6.30. Comparisons between Cationic and Free Radical Polymerizations. Dr P. H. Plesch. College of Advanced Technology.  
 (SS) **Blackburn.** 23 Feb. 7.30. Unusual Properties of Metal Nitrates. Prof. C. G. Addison. Technical College.  
 (P) **Brighton.** 3 Feb. 7.30. Research and Development in D.S.I.R. Stations. Sir Harry Melville. Technical College. Joint, College Chem. Soc.  
 (P) **Cambridge.** 22 Feb. 7.45. Application of Gas Chromatography to Kinetic Studies. Dr J. H. Furnell. Technological Research Station, Spillers Ltd, Station Road.  
 (E) **Cardiff.** 15 Feb. 7. Film Show. University College. Joint, S.C.I.  
 (P) **Dartford.** 13 Feb. 7.30. Reaction Mechanisms. Prof. E. D. Hughes. North-West Kent College of Technology, Miskin Road.  
 (J) **Edinburgh.** 21 Feb. 4.30. Pedler Lecture: Some Problems in the Chemistry of the Gallotannins. Prof. R. D. Haworth. University Chemistry Department, West Mains Road. Joint, C.S., S.C.I. and University Chem. Soc.  
 (W) **Exeter.** 24 Feb. 5. Lecture by Dr W. B. Ollis. Washington Singer Laboratories.  
 (K) **Glasgow.** 10 Feb. 7.15. The Genetic Effects of Atomic Radiation. Prof. A. R. Gemmell. Room 24, Royal College of Science and Technology.  
 — 24 Feb. 7.15. Ion Exchange. R. A. Wells and V. E. Gripp. Room 24, Royal College of Science and Technology. Joint, S.A.C.  
 (D) **Gloucester.** 23 Feb. 7.30. Titrations in Non-Aqueous Solvents. E. Minchin. Technical College.  
 (WW) **Grangemouth.** 23 Feb. 7.30. Petroleum Refining: a Chemist's View of Today and Tomorrow. E. LeQ. Herbert. Mahatma Restaurant.  
 (L) **Huddersfield.** 22 Feb. 7.30. Terylene Intermediates and Polymerization. Dr P. V. Youle. Catering Department, College of Technology. Joint, College Chem. Soc.  
 (M) **Hull.** 2 Feb. 7.30. Rubber in Chemical Plant. E. Allcock and J. L. E. Crompton. Organic Lecture Theatre, The University. Joint, Hull Chemical and Engineering Society.  
 — 16 Feb. 7.30. Industrial Application of Ion Exchange. Dr V. E. Gripp. Also Film: Ion Exchange Resins. Organic Lecture Theatre, The University.  
 (G) **Ipswich.** 14 Feb. 7.30. The Chemist as a Colleague. Dr W. Preston. Civic College.  
 (N) **Leeds.** 2 Feb. 7.30. Pottery Manufacture in Outline—Pioneers, Practice and Progress. Dr A. T. Green. University House. Joint, S.C.I.  
 — 22 Feb. 6.30. Some Chemical Aspects of Tropical Agriculture. Prof. R. L. Wain. Chemistry Lecture Theatre, The University.  
 (H) **Leicester.** 14 Feb. 7.30. Paper Chromatography of Dyesulfis. J. C. Brown. College of Art and Technology. Joint, College Scientific Soc.  
 (O) **Liverpool.** 2 Feb. 7. Some Aspects of the Chemical Structure of Proteins. Prof. H. D. Spraggall. Donnan Laboratories, Vine Street.  
 (P) **London.** 6 Feb. 6.30. Fuel Cells. Dr H. H. Chambers. Society of Chemical Industry, 14 Belgrave Square, S.W.1. Joint, S.C.I.  
 — 7 Feb. 6.30. Organic Reactions in Strong Alkalis. Prof. B. C. L. Weedon. Sir John Cass College, Jewry Street, E.C.3. Joint, College Chem. Soc.  
 — 15 Feb. 6.30. Some Recent Advances in Inorganic Chemistry. Dr J. S. Underwood. College of Science, W.C.1. Joint, S.C.I.  
 (X) **Norton.** 15 Feb. 8. Progress and its Effects on our Food Supplies. T. McLachlan. William Newton School.  
 (P) **Norwood.** 14 Feb. 7. The Work of a Public Analyst. T. McLachlan. Technical College, Knight's Hill, West Norwood, S.E.27.  
 (R) **Poole.** 24 Feb. 7.30. Some Factors in the Selection of Metals for Engineering Purposes. D. Birchon. Poole Generating Station. Joint, Poole and District Technical Group.  
 (FF) **St Andrews.** 10 Feb. 3.15. Hydrogen Bonding and some Crystal Structures. Dr J. C. Speakman. The University.  
 (EE) **Seascale.** 17 Feb. 8. The Chemistry of Colour Photography. Dr E. Macdonald. Windscale Club.  
 (U) **Sheffield.** 27 Feb. 7.30. Ladies' Evening: Cosmetics—a talk and demonstration. Chemistry Lecture Theatre, The University.  
 (P) **Southampton.** 10 Feb. 5. The Porphyrin Group of Natural Pigments. Prof. A. W. Johnson. The University. Joint, University Chem. Soc.  
 (Q) **Stockport.** 14 Feb. 7. Polymers that are different. Prof. R. N. Hazeldine. Technical College.  
 (V) **Swansea.** 17 Feb. 6. Hot Stage Methods in Chemical Microscopy. Dr N. H. Harthorne. Department of Chemistry, University College.  
 — 24 Feb. 7. Annual Dinner. Chief Guest, Mr E. LeQ. Herbert. George Hall, Guildhall.  
 (P) **Walthamstow.** 1 Feb. 7. Film Show. South-West Essex College of Technology, Forest Road, E.17. Joint, College Chem. Soc.  
 (T) **Wrexham.** 10 Feb. 7. Annual General Meeting. Denbighshire Technical College.  
 — 22 Feb. 7. The Chemistry of Vitamin B<sub>12</sub>. Prof. A. W. Johnson. Denbighshire Technical College.